WAGE DIFFERENTIALS AND TRADE RELATIONSHIPS IN JAMAICA: APPLICATIONS OF TRUNCATED REGRESSION MODELS AND REPEATED CROSS-SECTION DATA

By

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TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS ii

LIST OF TABLES v

LIST OF FIGURES vi

ABSTRACT vii

CHAPTERS

1 INTRODUCTION, BACKGROUND AND PROBLEM STATEMENT 1

Introduction 1
Background on Jamaica 3
Problem Statement and Purpose of the Study 9
Objectives 10
Overview of the Dissertation 11

2 THEORETICAL FRAMEWORK AND LITERATURE REVIEW 12

The Economics of Changes in Trade, Direct Investment, and Relative Wages 12
Analytical Models 15
A Heckscher-Ohlin Type Trade Model 15
A Model with Inter-Industry Wage Premiums 19
Literature Review 24
Theoretical Developments 26

3 ECONOMETRIC FRAMEWORK 28

Overview of the Data 30
Truncated Regression Models 31
Specification and Estimation 33
A Simultaneous Equation – Truncated Regression Model 37
A Model of Labor Supply 40
Data and Descriptive Statistics 45

4 ANALYSIS OF EMPIRICAL RESULTS 54

Parameter Estimates and Model Selection 54
Results and Discussion 66
Control Variables 66
Industry-Specific Wage Premiums 70
Wage Trade Correlations 73
The Agricultural Wage 76

5 SUMMARY, POLICY RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH 81

Summary and Conclusions 81
Policy Implications and Recommendations 86
Limitations of the Study and Suggestions for Further Research 87

APPENDICES

1 ALLOCATION OF JAMAICA INDUSTRIAL CLASSIFICATION (JIC) CATEGORIES TO THE STANDARD INTERNATIONAL TRADE CLASSIFICATION (SITC) SECTORS. 90

2 VALUE OF JAMAICAN IMPORTS AND EXPORTS BY SITC SECTORS (1989-1997) 91

3 PARAMETER ESTIMATES OF THE SIMULTANEOUS EQUATIONS MODELS WITH STANDARD ERRORS CORRECTED FOR MISSPECIFICATION 98

4 PARAMETER ESTIMATES OF THE LABOR SUPPLY MODEL: REGRESSION WITH STANDARD INDUSTRY WAGE-TRADE PREMIUMS 102

REFERENCES 104

BIOGRAPHICAL SKETCH 110

LIST OF TABLES

Table page

Table 2-1: Conceptual Pattern of the Directional Effects of Positive Trade Shocks on Wage Premiums: In Aggregate, and by Trading Partner 23

Table 3-1: Definitions of Control Variables and Summary Statistics 47

Table 4-1: Wage Equation Parameter Estimates from OLS and Truncated Regression: Maximum Likelihood (ML) 56

Table 4-2: Parameter Estimates for the (Hausman and Wise) Simultaneous-Equation Maximum Likelihood 58

Table 4-3: Parameter Estimates for the (Heckman Labor Supply Model) Simultaneous-Equation Maximum Likelihood 60

Table 4-4: Parameter Estimates for the Heckman Labor Supply Model: Simultaneous-Equation Maximum Likelihood (USA-Jamaica Trade) 62

Table 4-5: Parameter Estimates for the Heckman Labor Supply Model: Simultaneous-Equation Maximum Likelihood (Trinidad-Jamaica Trade) 64

Table 4-6: Estimated Variances and Covariance: Simultaneous Equations Models 66

Table 4-7: Base Regression Results for Control Variables: Labor Supply Model. 69

Table 4-8: Selected Coefficients (Standard Errors) of Real Log Wage on Trade Measures from Simultaneous Equations Model 74

Table 4-9: Analysis of the Effects of Trade Changes on the Wages of the Typical Unskilled and Skilled Employee 77

LIST OF FIGURES

Figure page

Figure 3-1: Wage, Skill, and Hours Worked by Age Group 48

Figure 3-2: Wage, Skill, and Hours Worked by Education Group 48

Figure 3-3: Wage and Skill by 1-digit SITC Section 49

Figure 3-4: Trade Growth for SITC0-Food: 1990-1997 (1989=1) 50

Figure 3-5: Trade Growth for SITC1-Beverages and Tobacco: 1990-1997 (1989=1) 50

Figure 3-6: Trade Growth for SITC2-Crude Materials: 1990-1997 (1989=1) 51

Figure 3-7: Trade Growth for SITC3-Mineral Fuels: 1990-1997 (1989=1) 51

Figure 3-8: Trade Growth for SITC5-Chemicals: 1990-1997 (1989=1) 52

Figure 3-9: Trade Growth for SITC6-Manufactured Goods: 1990-1997 (1989=1) 52

Figure 3-10: Trade Growth for SITC7-Machinery and Transport Equipment: 1990-1997 (1989=1) 53

Figure 3-11: Trade Growth for SITC8-Miscellaneous Manufactures: 1990-1997 (1989=1) 53

Figure 4-1: Industry-Specific Wage Premiums by Education Level (Deviation from Employment-Weighted Average Log Real Wage) 72

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WAGE DIFFERENTIALS AND TRADE RELATIONSHIPS IN JAMAICA: APPLICATIONS OF TRUNCATED REGRESSION MODELS AND REPEATED CROSS-SECTION DATA

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Radical trade reforms in developing countries over the last two decades have led to renewed interest in the effects of freer trade on income distribution in general, and on the wages of skilled versus unskilled employees in particular. Recent studies have reported conflicting conclusions for developed countries, and there remains a dearth of such studies for developing countries. The objective of this study is to investigate the relationships between trade, wages, and the reward to skill for Jamaican workers during the period 1990-98.

A model of compensating differentials, in the form of inter-industry wage premiums, is adopted and applied to repeated cross-section micro-level datasets to explain the differing wage levels between traded goods sectors, and also the rewards to differing skill levels within these sectors. Employees were categorized according to the

Standard International Trade Classification (SITC) single-digit codes for which annual import and export measures were available, both as aggregates and disaggregated by trading partners. The relationships of these trade measures with the wage premiums were estimated using various estimation methods, including single-equation and simultaneous-equation models, and also a labor supply model framework that equates a shadow price for labor with the offered wage. The data used were for employed individuals and represent a truncated sample, necessitating the application of truncated regression models that use maximum likelihood methods for estimation.

Three of the eight SITC industries were found to have wage premiums that increase with the educational level of employees. The findings also show that greater Jamaican trade with developed-country partners, characterized as vertical trade, is associated with increased rewards to skill and reduced rewards to pure labor on the imports side, consistent with heightened wage inequality and distributional conflict, while on the exports side, the reverse effect is observed--reduced wage inequality. Greater trade with developing-country partners, or horizontal trade, was found to have minimal or no effect on Jamaican wages. Together, the results suggest that what Jamaica trades, and with whom, is significant to wage inequality for Jamaican workers in the traded goods sector.

CHAPTER 1
INTRODUCTION, BACKGROUND AND PROBLEM STATEMENT

Introduction

Over the last century the gap between rich and poor countries has increased. The wealthiest country was 11 times richer than the poorest country a hundred years ago. According to the World Bank (1995), this ratio had grown from 11 to 50 by 1985. This is a distressing outcome in the context of globalization; it is particularly distressing for the countries that form the denominator of that wealth ratio. The wealthy countries, on the other hand, cannot ignore the situation, whether from the perspective of self-interest given concerns about immigration and specialized resources, or from the increasing concerns about labor and environmental conditions in other countries as witnessed at recent World Trade Organization (WTO) meetings. In addition, as countries such as the United States of America (USA) seek to expand trade in agricultural products, new markets are increasingly in developing countries where increases in incomes have large effects on the demand for USA goods. This begs the questions, "Is the wealth ratio likely to get larger?" and, "What can be done to raise the income levels of the poorest countries?"

Policy prescriptions for raising income levels are often contradictory, and maybe even more so for the poorest nations. Conceptually, providing employment opportunities

should alleviate poverty. However, there is no clear consensus regarding the best policies for expanding employment opportunities and raising the wage levels in developing countries. Trade theorists and policymakers have long argued that the opening up of trade is an integral part of economic reform and development. In fact, many now would argue that there are few remaining puzzles regarding the benefits of trade reform.

It is noteworthy that the most radical trade reforms in the last 2 decades have occurred in developing countries, and usually, the agricultural sector is the most significantly affected. Yet almost all the existing studies on trade-related labor adjustment tend to focus on industrial countries and their manufacturing sector. Davis and Haltiwanger (1991), Bound and Johnson (1992), and Katz and Murphy (1992) have documented that since the 1970s, the wages of skilled workers have increased relative to those of unskilled workers in the United States. Davis (1992) provides evidence of the same for Great Britain. Several recent studies link the rise in wage inequality to the increased openness of the USA economy. They argue that competition from low-wage countries has reduced the relative demand for unskilled workers and caused their wages to fall relative to those of skilled workers (Leamer 1993, 1998; Wood 1994, 1998; Feenstra and Hanson 1996). Other studies, such as Davis and Haltiwanger (1991), Bound and Johnson (1992), Lawrence and Slaughter (1993), Berman, Bound and Griliches (1994), conclude that the role of trade is small, and instead associate rising wage inequality with technological change. The reasoning here is that the advent of computer technology has made skilled workers increasingly more important in the workplace, and, as such, occupation-specific, rather than industry-specific, effects better explain the growing wage dispersion.

This focus in the literature on developed countries is unfortunate. If trade is contributing to wage changes in developed countries, then we should observe opposite wage movement in developing countries. If global skill-biased technological change is the cause of relative-wage changes, then we should observe similar relative wage movements in high-wage and low-wage countries. This study examines the Jamaican experience. The study will firstly investigate whether increases in returns to education are associated with particular tasks related to occupations or industries, or if they remain as returns to general education. It then seeks to determine the relationships between trade liberalization, wages, and the rewards to skill for different categories of workers. It will test the hypothesis that trade reforms in developing countries should be accompanied by employment and wage increases due to a reallocation of output toward low-skill, labor-intensive products. Given Jamaica's proximity to the United States and its recent economic reforms, the country is an ideal candidate in which to look for such changes.

Background on Jamaica

Jamaica, a former British island-colony, is a middle-income developing country, located in the Caribbean Sea (coordinates: 18.15 N, 77.30 W) with Cuba just 90 miles to its north. Its total land area, measuring 10,830 square kilometers (slightly smaller than Connecticut), currently supports 2.6 million people, with an annual population growth rate of .8%. Climatically, Jamaica is classified as tropical, with temperatures ranging from 23-33 °C. Officially, English is the national language, but a Creole, called "Patois," is spoken by nearly all the people.

Jamaica is a parliamentary democracy that gained independence from British rule on August 6, 1962. Queen Elizabeth II was, however, retained as the head of state, represented by a Governor General who is appointed by Her upon recommendation of the Prime Minister. For a large part of its post-independence period, Jamaica has been a two-party system, and its nine changes in government during this period have alternated between these two. Recently however, at least two additional political parties have become recognized.

Economic Indicators

Over the last decade, annual Gross Domestic Product (GDP) and growth rate for Jamaica averaged J$M 107,930 and 0.6, respectively. The economy has been plagued by persistent inflation but there has been some decline. The inflation rate was well over 40% in the early years of the decade but decreased to just over 16% by 1997. Interest rates however have remained high, with the loan rate averaging over 47.5% for the decade. Jamaica is also heavily indebted, and debt servicing averaged 18.8% of GDP, reaching 25.4% in 1994. These adverse conditions are also reflected in the devaluation of the Jamaican dollar with the exchange rate moving from J$ 7.18 per US$ in 1990 to J$ 35.58 in 1997. The country has, however, managed to improve its Net International Reserves position, moving from a low of US$M –67.4 in 1992 to US$M 692.6 in 1996.

The external sector has always played an important role in the Jamaican economy. Exports contributed an average of 31% to GDP over the past decade. Imports on the other hand averaged almost 60%. This pervasive trade deficit has steadily increased, from US$M 784.9 in 1990 to US$M 1,726.9 in 1997. This is, in part, due to a sluggish export

sector brought about by the high cost of investment funds and high production costs caused by domestic stabilization measures.

Development Strategy and International Trade

Like many other developing countries, in the first half of the 20th century Jamaica specialized in the production and export of primary products. Primary among these are sugar, bananas, coffee and cocoa, and beginning in the late 1950s bauxite–a raw material used to make aluminum. The implementation of this strategy in the early years relied on colonial powers, but control later shifted to multinational firms. By the 1960s, most commercial activities involved in production of primary products and in delivery of the basic infrastructure services (power, water, transportation) were controlled by British, American and Canadian multinationals.

In the early 1970s, the government moved to assume greater responsibility for economic development by pursuing a strategy of acquiring control of primary production and provision of infrastructure from the multinationals. Multinational firms continued to be prominent in the economy, but primarily through joint operations in businesses that were at least partially owned by the state. In the 1970s, faced with a growing trade deficit, the government sought to broaden the economic base by promoting a strategy of import-substitution industrialization. This required the government to provide protection for firms willing to produce goods locally that could substitute for imports. Initially, protection was provided for consumer goods produced from imported materials and components, with the expectation that firms would over time integrate backwards and begin to produce locally some of the intermediate materials and components they used.

The desired backward integration did not occur as quickly as envisaged, however, and by the 1980s, prompted by the advice of economists in developed countries and in the international financial institutions to which the country was by now deeply indebted, the strategy of economic development shifted once again. The new strategy of export promotion arose out of the apparent ineffectiveness of import substitution and the success of the export-led East Asian economies.

Since the 1980s, then, the Jamaican strategy of economic development has involved widespread economic reforms to restructure production, to promote exports, to increase productive employment and to reduce both external and fiscal deficits, while also satisfying certain social goals. The need for these reforms has also been driven by the restructuring of world markets, the inability of firms in some sectors of the Jamaican economy to compete internationally, and most recently, the changes in trading regulations and relationships. With the advent of the North American Free Trade Agreement (NAFTA) in 1994, Jamaica, along with other countries of the Caribbean Community (CARICOM) sought accession to NAFTA membership but ultimately failed in that regard. The initiative to launch a Free Trade Area of the Americas (FTAA) by 2005 continues to be the source of Jamaica's trade reform concerns as she prepares herself to be in a position for participation.

Agriculture and Trade

For Jamaica, one of the sectors most affected by reforms and international developments is agriculture. In the 1950s, agriculture dominated the Jamaican economy, accounting for 24 percent of GDP, 85 percent of exports, and more than 40 percent of employment. On the eve of independence in 1962, its contribution to GDP and exports

had fallen by almost half to 13 percent and 44 percent respectively, while still providing more then 35 percent of employment, indicating the decline in labor productivity in the sector. This decline has continued over the decades, and in 1997 agricultural GDP stood at 8 percent, its contribution to exports 13 percent, yet still provided 24 percent of employment.

Under structural adjustment, Jamaica undertook an extensive revision of its trade regime, as a condition for the Trade and Financial Sector Adjustment Loan (1987), and the Agricultural Sector Adjustment Loan (1990) from the World Bank. It was the latter that had the major impact on agriculture. Where agricultural commodities were protected with quantitative restrictions and other non-tariff barriers, these were converted to tariffs. A schedule for the reduction of these tariff rates was implemented to bring domestic tariffs in line with CARICOM's Common External Tariff (CET). The Government also agreed to eliminate all stamp duties (levied in addition to import duties) over a three-year period up to March 1995. Jamaica has also led others in CARICOM to lower the CET on a wide range of imports while spreading the tax burden across a wider range of commodities. Tariff rates currently vary from 5 per cent on non-competing primary inputs to 25 per cent on general manufactures.

The liberalization of the Jamaican economy has brought competition to the producers of many domestic foodstuffs. Poultry and dairy farmers have faced stiff competition from imported leg quarters and milk solids. Several of these producers have cut back production and delayed the implementation of investment plans. Some have withdrawn from these industries in the face of huge losses and the inability to repay

loans. Other producers, such as those of potatoes, carrots, tomatoes, onions and other vegetables, and some fruits, have also been unable to compete with imports.

The traditional agricultural export subsector also has its problems. Preferential access under the ACP-EU LOME agreement allowed Jamaica to sell into the EU market, even though banana producers in Jamaica have been less productive than some Latin American competitors, and the fall in beet-sugar prices has seen a fall in prices obtained for cane-sugar exports from Jamaica. Given the strong opposition by the US to such preferential access, the future of the LOME agreement signed in 2000 comes into question. This is of particular importance to Jamaica given that the EU is the only region with which Jamaica has consistently maintained a trade surplus. The concern raised is whether preferences as granted under the LOME agreement have obtained the desired results such as improved competitiveness and export growth for the ACP group as a whole. It is argued that these preferences may have permitted ACP countries to continue to produce commodities for which they have lost competitive advantage and discouraged the diversification of their export base.

Although the data suggest that over the last decade real wages have increased for the economy as a whole, agricultural workers have suffered a decline in real purchasing power as prices have been allowed to run ahead of wage increases. Income policies have contained wage increases, while prices of food and other basic consumption goods and services have risen as a result of devaluations, deregulation and the removal of subsidies from the public budget.

The manufacturing sector also faces the erosion of preferences under the Caribbean Basin Economic Recovery Act (CBERA) and the Canadian Program for

Commonwealth Caribbean trade (CARIBCAN), signaling the end of an era in which Jamaican firms could export even though their productivity was below global standards.[1] Such developments increase the urgency with which Jamaica must move to promote alternative sources of employment and export revenue. This includes identifying industries and activities that will provide the highest returns to factor inputs.

Problem Statement and Purpose of the Study

During the late 1980s and early 1990s the Jamaican economy experienced a period of profound change: a wider and deeper commercial opening to trade and foreign investment; the privatization of many state-owned enterprises; major tax reform; deregulation of industry; and a major restructuring of the financial sector. These reforms coincided with dramatic changes in the Jamaican labor market. During the 1989-1998 period the average real wage and employment grew by 26.8% and 6% respectively (Labor Force Module: Jamaica Survey of Living Conditions, 1989-98).[2] These changes were accompanied by a dramatic increase in wage inequality across and within education and experience groups. Workers with post-secondary education and more experience saw their wage rise rapidly while less-skilled workers experienced only slight wage growth.

Beyond its interest in relation to the potential effects of liberalization on its development, Jamaica's recent trade liberalization experience can be relevant to many other developing countries embarking on a similar process. One of the main concerns regarding any liberalization experience is its potential effect on employment and wages in

[1] CBERA preferences have been extended under the new USA CBI-Africa trade bill (Caribbean Update (2000)); CARIBCAN is currently being renegotiated (Caribbean Update (2001)).
[2] These growth measures were obtained from preliminary analysis of the data. World Bank (1999) gives basic information on these data.

the affected sectors. Understanding what the employment costs were in the Jamaican case, and how they could be dampened, may thus provide some useful lessons. Moreover, the Jamaican experience should illuminate, more generally, the links between labor market adjustment and increasing global competition. As more and more developing countries have opened up to international markets, concerns over the inevitable decline of industrial country wages--hypothetically dragged down by competition with lower-cost, labor-abundant producers--have mounted. Does the Jamaican experience suggest that this concern is warranted? Or, on the contrary, does it point toward common trends across developing and industrial countries?

With these general objectives in mind, this study analyzes the effect of the recent Jamaican trade liberalization on employment and wages across major sectors of the economy. The study seeks to determine whether wages and employment in the Jamaican economy declined following liberalization, and it examines the mechanisms for that adjustment.

Objectives

The primary objective of this study is to determine the impact of trade liberalization on the employment and wages of different levels of skilled workers in selected sectors of the Jamaican economy. Secondary objectives include the following:

1) To identify industry wage premiums in the Jamaican economy.
2) To identify skill premiums for Jamaican workers.
3) To quantify the effects of worker characteristics and other factors on wage determination in Jamaica.

4) To provide information to the development, planning, and policy communities on the importance of trade reforms on the development process with particular reference to wage earnings in different sectors.

Overview of the Dissertation

The manuscript is laid out in five chapters. Following this introductory section, Chapter 2 outlines the theoretical and analytical frameworks that form the basis for the study, reviews a number of empirical studies that have addressed the issue of trade and wages, and briefly looks at theoretical developments in the literature. Chapter 3 discusses data and econometric issues, and models for estimation are developed. Descriptive statistics of the data used are also given. Empirical results are presented and discussed in Chapter 4, and the final chapter consists of a summary, conclusions drawn and policy suggestions.

CHAPTER 2
THEORETICAL FRAMEWORK AND LITERATURE REVIEW

The Economics of Changes in Trade, Direct Investment, and Relative Wages

Neoclassical economic analysis concludes that changes in a country's pattern of trade or direct investment affect its aggregate level of employment only temporarily (Mankiw, 1997). In the long run, macroeconomic factors operate to bring employment to the level where unemployment is at its so-called "natural rate". This natural rate is determined by various structural features of an economy, such as the demographic composition of the work force, the degree of wage flexibility, the minimum wage level, the extent of product-market competition, and the generosity of various social welfare programs.

From a starting point where unemployment is at its "natural" rate and the balance of payments is in equilibrium, we can consider, for example, the effect on aggregate employment of a unilateral reduction in a country's tariffs. This policy change tends to increase the country's imports relative to its exports, as foreign goods become relatively cheaper. In an economy with a fixed exchange rate where money wages tend to be rigid in the short run due to the existence of overlapping wage contracts, the switch towards foreign goods and the resulting trade deficit causes a reduction in income and employment levels in the country. Furthermore, if the monetary authorities do not act to offset the decrease in the money supply brought about by the deficit; interest rates will

rise, leading to a fall in domestic investment, which, in turn, will reduce income and employment even further. However, as wage contracts expire and are renegotiated, the existence of the larger pool of unemployed workers acts to reduce money wages relative to prices, i.e., real wages decline. This causes firms to increase employment as their unit costs fall and profits increase. The balance of trade also improves as domestic prices fall relative to foreign prices. The adjustment process continues until the "natural" rate of unemployment is restored and the balance of payments is again in equilibrium. To the extent that exchange rates are flexible, a depreciation of the country's currency in response to the initial deficit tends to facilitate the return of employment to its initial level.

There is abundant evidence from many countries' experiences with business cycles in the post-World War II period that this macroeconomic adjustment process generally tends to correct for both less-than-full employment and over-full employment conditions. However, the lengthiness of the process often leads to calls for policy actions aimed at mitigating the adverse consequences of the disequilibrium situation--policy actions designed to prevent the economic shock that leads to this condition. Furthermore, the existence of high unemployment rates in a number of countries over the last two decades, especially in Europe, suggests that the "natural" rate of unemployment has risen in some countries. Thus, policy makers are understandably concerned over the employment effects of such international economic shocks as shifts in the volume and composition of trade and foreign investment and significant changes in exchange rates.

Whereas the economic analysis indicates there are strong forces tending to restore employment to its "natural" level after an economic shock disturbs this condition, no

such parallel exists when it comes to shocks that cause changes in relative wages. There is no "natural" relative wage pattern to which an economy tends to return through market forces after relative wages have been changed by some exogenous economic shock. A country's structure of wages depends on such factors as the nature of its technology, factor endowments, domestic and foreign preferences for goods and services, institutions, and public policies relative to those of other countries.

The factor-proportions theory of international trade focuses, for example, on cross-country differences in relative factor endowments as the cause of trade and determinant of relative factor prices, assuming that technology and tastes are similar among countries. Factors that are relatively scarce in a country will be relatively expensive in the absence of trade, while those that are relatively abundant will be comparatively cheap. Thus, the wages of skilled workers will be high relative to those of unskilled workers if the country's supply of skilled labor is scarce relative to other countries and its supply of unskilled labor is relatively abundant. These conditions give the country a comparative cost advantage in goods that intensively use unskilled labor and a comparative disadvantage in skill-intensive goods, and it will, on average, export the first type of goods and import the other. This pattern of trade will, in turn, tend to bring the structure of relative wages and other factor prices closer together across countries.

In contrast, the Ricardian trade model emphasizes relative differences in technology across commodities as the cause of differences among countries in comparative costs and in relative factor prices. If, for example, a country's relative factor endowments are no different than the rest of the world, its technology may give the

country a productivity advantage in producing skill-intensive goods. Since in the absence of trade, these goods will be relatively cheaper in the home country than in the rest of the world, they will be exported as trade is opened up. This, in turn, tends to raise the wages of skilled relative to unskilled workers in the home country, while having the opposite effect in the rest of the world.

The nature of institutions, preferences, and public policies also play a significant role in determining the structure of relative wages and other factor prices. The degree of unionization among various skill groups and the minimum wage level imposed by the government obviously affect the relative wages. Similarly, the magnitude of resources that a country devotes to higher education, and the country's propensity to save, have important implications for the pattern of factor prices over time.

Analytical Models

This section explores a theoretical approach in understanding the wage implications of trade shocks in the context of a small open price taking economy that has an abundance of unskilled labor. This approach represents a restricted version of the simple Heckscher-Ohlin (H-O) trade model--the most commonly used in conducting analyses of the contribution of trade and other factors to wage inequality.

A Heckscher-Ohlin Type Trade Model

Exploring the model begins by outlining a H-O type trade model with two factor inputs (skilled and unskilled labor) and two outputs (skilled labor intensive, and unskilled labor intensive outputs), where the economy in question is a taker of goods prices on world markets. This structure differs from the classical 2-country, 2-good, 2-factor H-O

model in which relative factor abundance across countries determines the pattern of trade. The model type presented here contains two goods and two factors, but there is only one (small price taking) country, and the base case pattern of trade is determined by the own country's comparative advantage, not relative factor abundance. Both skilled and unskilled labor are mobile between sectors but are internationally immobile. Trade shocks are modeled as world price changes, and other shocks (such as technology) as factor specific shocks.

Production in the H-O model

The small open economy produces two goods, *M* and *E* (importable and intensive in skilled labor, and exportable and intensive in unskilled labor, respectively), both of which are traded at fixed world prices. The economy then, can be classified as an exporter of primary products. The production of each good requires the use of two factors: skilled labor, *S*, and unskilled labor, *U*. Each good is produced using a constant return to scale technology, with constant elasticity of substitution (CES) between *S* and *U*. The production function is given as

$$(3-1) \qquad Q_i = \gamma_i \left[(1-\alpha_i) S_i^{-\beta_i} + \alpha_i U_i^{-\beta_i} \right]^{-1/\beta_i} \qquad i = M, E$$

where Q_i represents output, and $1 - \alpha_i$, α_i, and β_i are given parameters. The elasticity of substitution between U_i and S_i in this case is $\sigma_i = 1 / (\beta_i + 1)$.

The endowments of skilled and unskilled labor are taken to be fixed (there is no labor-leisure choice), and to be equal to $\bar{S}$ and $\bar{U}$, respectively. Full employment of each type of labor is assumed. It is also assumed that labor markets are competitive so that each type of labor is paid its marginal value product, i.e.,

$$(3-2) \qquad W_s = [(1-\alpha_i) P_i (Q_i / S_i)^{1+\beta_i}] / \gamma_i^{\beta_i} \text{ and}$$

$$(3-3) \qquad W_u = [\alpha_i P_i (Q_i / U_i)^{1+\beta_i}] / \gamma_i^{\beta_i} \qquad i = M, E$$

where W_s and W_u denote skilled and unskilled wage rates, respectively, and P_i is the (fixed) world price of good *i*.

Trade in the H-O model

Imports and domestically produced goods are homogeneous, as is also the case with exports (i.e. trade is of H-O form). This homogeneity assumption implies that trade flows involving any good are only one-way, i.e. one of the goods is exported and the other imported.

In equilibrium, trade balance will hold, i.e.,

$$(3-4) \qquad \sum_{i=M,E} P_i T_i = 0$$

where the T_i denote the net trade of the country in the two goods, *M* and *E*. If good *i* is exported, domestic production less consumption is positive; if good *i* is imported, this difference is negative.

Equilibrium and Market Clearing Conditions

Given the small open economy assumption, equilibrium in this model is given by skilled and unskilled wage rates, such that the two domestic labor markets clear, i.e.,

$$(3-5) \qquad \sum_{i=M,E} S_i = \overline{S}$$

$$(3-6) \qquad \sum_{i=M,E} U_i = \overline{U}$$

Consumption of each good *i* is given by the difference between production and trade, i.e.,

$$(3-7) \qquad C_i = Y_i - T_i \qquad i = M, E$$

where C_i denotes consumption of good i. Production of each good, in turn, is given by using equations (3-2), (3-3), (3-5) and (3-6) and solving for Y_i, along with W_s and W_u as part of the equilibrium.

Abrego and Whalley (1999) used this H-O type model (albeit for a skilled-labor abundant economy--the United Kingdom) to investigate the decomposition of a total wage rate effect from a joint trade-technology shock into separate trade related and technology components. Trade shocks were represented by world price changes that generate more trade and given by reductions in the relative price of unskilled-intensive to skilled-intensive products, while technology changes were determined firstly by residuals needed to yield a model solution, and then by changes in the share parameters applying to skilled and unskilled labor in the production function. Technology changes were assumed to be factor specific, and occurred only for unskilled labor. They showed that since share parameters in each production function sum to one, an adverse shock biased against unskilled labor lowers the share parameter on unskilled labor relative to that for skilled labor for the same sector. They conclude that this simple H-O type model proves unsatisfactory for the task of decomposing data on wage inequality into separate trade and technology components because of the near linearity of the production function, and the associated problems of specialization.[3] The model thus produces a wide range for the decomposition of the parameters. They also argue that a more general H-O model with differentiated goods removes problems of specialization and concentrates the range of decomposition more narrowly, but introduces larger demand side responses to trade shocks, which greatly reduce the effect of trade.

[3] Johnson (1966) discusses this numeric property of production frontiers generated from conventional functional forms and fixed economy wide endowments.

A Model with Inter-Industry Wage Premiums

In order to avoid the inherent problems of the H-O type models, and given the enormous data requirements for analyzing such general equilibrium models, it is useful to consider a second approach that uses the inter-industry variation in wages to assess the relationship between increased trade liberalization and the relative return to skill. This approach has the advantage of being both empirically tractable and policy relevant. Much of the concern about heightened trade is its effect on "good jobs"--sectoral jobs that pay above average wage--an issue that requires one to deviate from models in which all similar workers receive the same return, regardless of the sector in which they are employed. Indeed such inter-industry wage premiums for comparable workers are a ubiquitous "fact of life" for both industrial and industrializing countries (Cragg and Epelbaum (1996), Krueger and Summers (1988)).

The existence of inter-industry wage premiums remains a puzzle for labor economists. Wage premiums may be attributable to the fact that the industry of affiliation is important per se--as in the case of compensating differentials. It may also be that industry affiliation is systematically correlated with unobserved worker attributes--as would result from a worker sorting process based on unobserved ability. Gibbons and Katz (1992) show that it may be from both, and provide a thorough discussion of the possible sources of wage premiums. For this study, a broad version of the former approach is taken, treating industry premiums as compensation for particular industry characteristics.

The model used here deviates from the standard neoclassical assumptions to permit inter-industry wage premiums. The labor market is modeled in a partial equilibrium context and a general form of compensating differentials is assumed to explain the existence of industry-specific wages. Each firm takes the outside wage as given, but pays a premium to compensate workers for loyalty, firm-specific skill acquisition, or for the disutility for higher effort, longer work weeks and unpleasant or risky working conditions associated with employment in the industry. Firms are assumed to face two distinct labor market-segments, one for unskilled workers and another for skilled workers. It is assumed that the (dis)utility arising from employment in the industry varies within the population and that workers in each market-segment can be arrayed from those who experience low to those who experience high (dis)utility from working in a given industry. Based on these supply conditions, a firm in a particular industry faces an upward sloping supply curve for labor of either type.

It is assumed that the demand curve for each type of labor for a given industry is downward sloping. It is conceived that changes in the volume of trade constitute shocks to the demand for labor. Changes in the volume of trade arise outside the industry from fundamental shocks such as endowment changes in trading partners or in the global demand for industry output. For this unskilled-labor abundant economy, it is assumed that imports substitute for skilled labor-intensive activities within the industry. Consequently, an increase in imports in the same industrial classification is viewed as a negative shock to the demand for skilled labor. Given an upward sloping supply of labor to the industry, this shock should result in a reduced premium for skilled workers. If the size of the industry is held constant, increased imports imply a shift within the domestic

industry toward labor-intensive activities. It is therefore expected that increases in imports are associated with a higher premium for unskilled workers. The higher premium is necessary to attract additional workers--who have a higher disutility from industry characteristics--into the industry.

Increased industry exports are assumed to correspond to increased demand for unskilled labor, just as imports do. Exports are likely to be based on comparative advantage, and, thus, to raise the relative demand for labor-intensive inputs and processes, and lower demand for skilled workers. Thus a larger flow of exports, like imports, should be associated with a higher premium for unskilled labor and a lower premium for skill.

This model presents a framework for thinking about the effects of trade shocks on industry-specific returns to skilled and unskilled labor. With some additional theoretical assumptions, the model framework can also be used to determine the effects by type of trading partner. Following Lovely and Richardson (1998) who developed on Ethier's (1982) model of international division of labor and Feenstra and Hanson's (1996) model of outsourcing, the country can be seen to be involved in "vertical" and "horizontal" trade with different trading partners. Vertical trade will take place between a developed country and a developing country. The former is assumed to have an abundance of human capital and thus produce goods that use this factor intensively. Trade between the two then, will likely be characterized by an exchange of skill-intensive final manufactures from the developed country, and raw materials and labor-intensive producer intermediaries from the developing country. The foregoing comparative statics for the basic model will obtain for the case of vertical trade. That is, in the given

framework, the distributional pattern of the effects of trade on wage premiums, will essentially be the same if either aggregate trade, or trade with developed countries, is considered--both imports and exports should be associated with higher premiums for unskilled labor, and lower premiums for skilled labor.

Horizontal trade between partners will take place where both partners are assumed to have similar endowments and are involved in similar productive activities. The goods from such activities are traded freely between the two, and factor-price equalization will obtain in equilibrium. As such, these partners together are treated as an integrated equilibrium. For a small open economy with an abundance of unskilled labor, trade with another developing country with similar endowments can be assumed to be horizontal. Such trade will likely be in producer intermediaries and small manufactures that use the abundant factor, unskilled labor, intensively.

With these assumptions, it is conceived that within this integrated equilibrium, an increase in industry imports from one developing country to the next is a negative shock to the demand for unskilled labor in the domestic industry. Imports from developing countries are viewed as substitutes for labor-intensive inputs and processes, reducing the demand for unskilled labor in the domestic industry. This shift in the demand for unskilled labor moves the industry down the labor supply curve, reducing the premium paid to less skilled workers. If industry size is held fixed, the composition of domestic production shifts away from labor-intensive activities toward skill-intensive activities. Thus, an increase in imports from other developing countries should be associated with an increase in the premium paid to skilled labor in the domestic industry.

Conversely, industry exports to developing country partners are expected to raise the relative demand for unskilled workers and lower the demand for skilled workers within industries. Such exports should therefore be associated with higher premiums for pure labor and lower premiums for skilled workers.

A summary of the distributional pattern of the wage effects of trade, in aggregate, and by different trading partners, is presented in Table 2-1. In the following section this conceptual framework is used to develop methods for estimating the correlations between wage premiums and trade flows.

Table 2-1: Conceptual Pattern of the Directional Effects of Positive Trade Shocks on Wage Premiums: In Aggregate, and by Trading Partner

	Total Trade		Developed Partner		Developing Partner	
	Labor Premium	Skill Premium	Labor Premium	Skill Premium	Labor Premium	Skill Premium
Industry Imports	+	-	+	-	-	+
Industry Exports	+	-	+	-	+	-

The magnitude of the wage premiums across industries, and hence the magnitudes of the wage correlations are, however, indeterminate. When pulling from a large pool of unskilled labor, firms may not have the incentive to pay wages in response to product changes, especially in an environment where unionization and minimum wages are ineffective[4]. Discussing the inter-relationships of a wage-gap model for the Jamaican case, Tidrick (1975) points out that the level of unemployment is a function of the wage structure, and wage increases in the high-wage sector alter the wage structure and also make unemployment more attractive for some workers. Agenor (1996) also supports the

[4] Several researchers have found evidence against the usual gains of unionization and minimum wages in Jamaica, e.g., Tidrick (1975), Agenor (1996), World Bank (1996), Alleyne (2000).

view that for the Jamaican economy, the overall impact of trade liberalization on employment is not certain.

Literature Review

Several studies have estimated the impact of trade on relative wages. Some of these use sectoral trade balances (expressed as shares of domestic consumption) as an independent variable; others use measures of trade prices. In these studies, results are sometimes not significant, and in some cases increased trade is associated with relatively higher rather than lower levels of industry wages. Freeman and Katz (1991) find a small but statistically significant relationship between imports and wages, as do Lawrence and Lawrence (1985). Grossman (1987) found a link between trade prices and industry wages, but in only two of the nine industries he examined. Larre (1995) pooled cross-sectional and time-series data from twelve countries and found that the most significant relationships between import competition in general and relative employment and wages were in high-skill industries, contrary to the belief that high manual industries are more vulnerable to changes in trade competition. In some cases, however, particularly in Europe, increased import penetration was associated with higher rather than lower average compensation. Similarly, Neven and Wyplosz (1996) obtain diverse results. Reduction in import prices was associated with increases in wages and employment in twenty-eight cases, and decreases in fifty-three. Messerlin (1995) finds that in France wages of skilled workers move differently in export- and import-competing industries.

Evidence in the literature also suggests that both labor-market and product-market structures affect wage and employment responses. Gaston and Trefler (1994) find in the

United States that union wage premiums are sensitive to import competition, whereas nonunion premiums are not. McPherson and Stewart (1990) conclude that a 10 percent rise in the share of imports lowered the union wage differential by 2 percent, although in general wages of both union and nonunion workers were far less sensitive to imports as the percentage organized increased.

Oliveira-Martins (1994) in his study of relative wages in twenty-two sectors across twelve OECD (Organization for Economic Cooperation and Development) countries divides sectors into different categories on the basis of concentration and product differentiation. He finds that import penetration tends to reduce wages in industries with low product differentiation, whereas the relationship between import growth and average wages is positive in industries with high product differentiation. For the United States, Galbraith and Du Pin Calmon (1993) find that in low wage sectors competition from developing countries has strong disciplining effects, but it does not in high-wage sectors. They also find that relative wages in heavy industry are not depressed by import competition.

Oliveira-Martin's results and those of others finding a positive association between wages and imports have several implications. The first is that adjustment takes place in some sectors through relative employment changes rather than wage changes. The second may be that trade tends to displace low-paid (mainly unskilled) workers, thus affecting average wages through the shifting of the labor-force composition. A third is that a positive effect may be brought about as a result of unions engaging in endgame bargaining, seeking to extract rents. This would support a model laid out by Lawrence

and Lawrence (1985). A fourth implication, however, is that of reverse causation: high wages lead to a loss in competitiveness and thus increased imports.

Revenga (1992) ascribes negative findings to a failure to correct the trade variable for endogeneity. Using two-stage least squares instrumental variables techniques, she finds statistically significant effects linking import prices to industry employment and wages (positively), although she estimates the impact on wages to be much smaller than on employment. Import price elasticities range from 0.24 to 0.39 for employment and from 0.06 to 0.09 for wages. Revenga concludes that the relative size of these elasticities suggests that labor is quite mobile across industries, and that the impact on the return to labor of an adverse trade shock in a particular industry seems to be quite small.

Theoretical Developments

One departure in the literature on trade and income distribution is in the abandonment of the assumption of exogenous technical change. In a study on the pattern of skill premiums across countries, Acemoglu (1999) uses the Romer (1990) model of endogenous technical change to argue that skill premiums are determined by technology and the relative supply of skills. An increase in the relative supply of skills, with technology held constant, reduces the skill premium. Among countries sharing the same technology, those with greater supplies will therefore have lower skill premiums. An increase in the supply of skill over time, however, induces a change in the technology, thereby increasing the demand for skills. As a result, the relationship between relative supplies and the skill premium over time may be increasing, even for countries developing their own technologies.

In his analysis, Acemoglu also found that, with technology held constant, an increase in the volume of international trade increases the skill premium in countries where skills are abundant, and reduces it in skill-scarce countries. However, trade also induces skill-biased technical change, creating a push towards higher skill premiums in both skill-abundant and skill-scarce countries. Acemoglu concludes that trade opening can cause increased income inequality in developed and in least developed countries, and the induced skill-biased technical change implies that this can happen even without a rise in the prices of skill-intensive goods in the developed-countries.

Dinopoulos et al. (1999) use the Chamberlin (1933) model of monopolistic competition, and introduce quasi-homothetic preferences for varieties, non-homothetic production and endogenous factor supplies of high and low-skilled workers to show that moving toward freer intra-industry trade raises the relative wage of high-skilled workers, the size of the representative firm, the level of total factor productivity (TFP), and the proportion of high-skilled workers employed within each firm, and that these effects are experienced by both trading partners.

CHAPTER 3
ECONOMETRIC FRAMEWORK

The econometric approach adopted here is a modification of a standard two-step procedure used by Dickens and Katz (1987), Dickens and Lang (1988), Katz and Summers (1989), and Gaston and Trefler (1994) for estimating industry wage premiums and their correlation with trade flows. The method is to distill a pure wage premium and a separate industry-specific premium to skill. In this approach skill is associated with years of formal education. In the first stage of this procedure, industry wage premiums are estimated. These estimates are used as dependent variables in a "second-stage", designed to estimate the relationship between unskilled and skilled premiums and industry specific trade flows. The modification of the procedure, first used by Lovely and Richardson (1998), is to simultaneously estimate an industry premium to pure labor, an industry-specific return to education (skill), and the relationship of these premiums to trade flows, in a one-step procedure.

Let $i = 1,2,\ldots, Ij$ index workers in industry j, and $t = 1,2,\ldots, T$ for the years covered by the sample. Let ln (w_{ijt}) be the natural logarithm of the hourly wage of individual i in industry j in year t, X_{ijt} be a vector of individual characteristics that affect wages (Mincer (1974)), S_{ijt} the years of schooling of individual i in industry j, T_{jt} a vector of measures of trade flow for industry j, and Z_{jt} a vector of industry characteristics other than trade. Estimates are obtained for the following equation for the whole sample period:

$$(3-1) \quad \ln(w_{ijt}) = X_{ijt}\beta_x + \sum_{j=1}^{J} D_{ij} w_{Lj}^{*} + \sum_{j=1}^{J} D_{ij} S_{ijt} w_{Sj}^{*} + T_{jt-1}\beta_L^{*} + T_{jt-1} S_{ijt} \beta_S^{*} + Z_t \rho_L + Z_t S_{ijt} \rho_S + \varepsilon_{ijt}$$

where D_{ij} is a dummy for industry j, β_x, w_{Lj}^{*}, w_{Sj}^{*}, β^{*}_L, β^{*}_S, ρ_L, and ρ_S are parameters to be estimated, and ε_{ij} is an error term assumed to be independent and identically distributed. Lovely and Richardson interpret the parameter w_{Lj}^{*} as the average premium paid to pure labor in industry j over the sample period. Likewise, w_{Sj}^{*} is interpreted as the average premium paid to skill (each year of formal education) in industry j over the period covered by the sample. The parameters β^{*}_L and β^{*}_S indicate the respective relationships between w_{Lj}^{*}, w_{Sj}^{*} and the measures of trade. The trade measures used in this analysis are trade flow indices: industry imports and exports indexed from the first year in the sample period. The parameter vectors β^{*}_L and β^{*}_S are therefore both two column vectors, the former indicating the separate effects of exports and imports on the premiums paid to pure labor in the traded goods industries, the latter determining the effects of exports and imports on the skill premiums paid in these industries. Hypotheses on the relationships between trade and wages can be tested against the estimates obtained for these parameters. Current trade volume shocks are, however, not independent of shocks to industry labor demand curves, (even with the small-country assumption made in the present case), and are therefore endogenous. Revenga highlights the importance of correcting for the endogeneity of the trade variables, pointing out that along with the usual arguments for the large-country case, correlation between trade variables and the disturbances of a wage equation could likely arise through an unobservable worldwide cost shock that can affect the price of the traded good, citing as an example, an unmeasured shock to the cost of input materials. Moreover, since any trade shock is

likely to have a delayed effect on the labor market, the lagged, predetermined values of the trade measures, T_{jt-1}, are therefore used instead.

To control for general-equilibrium factor return changes, that is, economy-wide changes in the return to labor and human capital that affect the economy as a whole but are not related to trade patterns in particular industries, a year trend, and the interaction of this variable with education, are included among the elements of Z_t. Lovely and Richardson also included a variable for industry producer price index and its interaction with skill to control for factor return changes due to changes in industry product prices. These variables were not included in this analysis because of the small-country assumption employed.

Overview of the Data

This study uses pooled micro-level data from the labor force module of the Jamaica Survey of Living Conditions (JSLC) 1990-1998. The JSLC is part of the Living Standards Measurement Survey (LSMS) administered by the Poverty and Human Resources Development Group of the World Bank as part of their data collection efforts in developing countries. The annual surveys are conducted by the Statistical Institute of Jamaica (STATIN) and administered by the Planning Institute of Jamaica (PIOJ). The labor force module contains annual wage and employment data for the nine-year period 1990–1998, and may be characterized as repeated cross-sectional data (as against panel data) since the sample of respondents was changed at least twice over this period. The data are statistically representative and are from household surveys that partially describe family composition, human capital acquisition, and experience in the labor market. The

data also include information on individuals' occupation and the industry in which employed. The primary sources for data on trade measures and industries are from the STATIN publication, External Trade--various years, and the PIOJ publication, Economic and Social Survey of Jamaica--various years.

Truncated Regression Models.

Empirical studies do not always attain the ideal of one-man-one-vote. More importantly, policy interests, for reasons good or bad, often lead to information-gathering efforts that are directed toward a particular part of the population, systematically including some individuals and excluding others. For example, in labor market studies, the researcher may be especially interested in persons with white-collar jobs, or with high levels of education, or the unemployed. But existing datasets may contain large bodies of data of potential value in a variety of investigations, some not directly related to the primary or original goals of the researcher. Selecting a sub-sample from such datasets, with the criterion that the dependent variable is cut off below or above some value, is said to be a truncated sample. For many purposes, the truncation poses a statistical problem. When the truncation is based on earnings, uses of the data that treat components of earnings--specifically, wages or hours--as dependent variables in a least squares regression framework will lead in general to parameter estimates that are biased towards zero and are also inconsistent, Tobin (1958), Amemiya (1973), Heckman (1974), Hausman and Wise (1977), Maddala (1983), Greene (1997). To see this, suppose we wish to use a sample with earnings truncated below a certain point, to estimate the effect of years of schooling (X) on earnings (Y). The regression equation is:

$$(3-2) \qquad Y_i = \beta X_i + u_i$$

where u_i is an error term assumed to be independent and identically distributed with mean zero and variance σ^2, that is, $u_i \sim IID\ (0,\ \sigma^2)$. We need to take into consideration that the dependent variable is truncated at a certain point. If the truncation is at zero, that is, observations with non-positive values of Y are not included in the sample, we observe Y_i only if $Y_i > 0$. This condition implies that $\beta X_i + u_i > 0 \Leftrightarrow u_i > -\beta X_i$. Clearly, the expectation of the error term is not equal to zero, that is, $E(u_i \mid u_i > -\beta X_i) \neq 0$. In fact, the mean of the error term will be a function of the X_i. Thus the residual is correlated with the explanatory variable X_i, and we will obtain inconsistent estimates of the parameter β if we use the OLS method. In this case, because β is expected to be positive, and because $E(u_i \mid u_i > -\beta X_i)$ decreases with increasing values of X_i, we get the result that the OLS estimator of β will be downward-biased; that is, estimating the effect of years of schooling on income from data generated by truncating the income variable gives us an underestimate of the true effect if we use the OLS method.

In light of the original goals and focus of this study, and the ensuing data gathering efforts, the sample used for this study utilizes only observations on employed individuals. The JSLC labor force module however, also includes observations on individuals that are unemployed and also those not actively seeking a job. The study sample is therefore not randomly drawn from the population (unlike the JSLC sample), but is a truncated sub-sample selected upon the criterion that the dependent variable–wage earnings–has positive values. Amemiya (1973) has proven that consistent and asymptotically efficient parameter estimates can be obtained from such a sub-sample by applying maximum likelihood procedures that take this truncation into account. These estimation procedures

have become known as truncated regression models. Although similar to Tobin's (1958) model, truncated regression models are distinguishable from the Tobit specification. Here, only observations above a particular value of the dependent variable are kept and thus corresponds to a truncated sample, while the Tobit case corresponds to a censored sample since all observations are kept but an assigned value is given to the dependent variable where it is unobserved.

Specification and Estimation

The specification and estimation of truncated regressions are dealt with in details in a number of textbooks; see for example, Johnson and Kotz (1970), Maddala (1983), and Greene (1997). The following section pulls from Greene (pp. 948-958).

The truncated regression model can be expressed mathematically as

$$(3-3) \qquad Y_i = \beta X_i + u_i > c \qquad \text{included,}$$

$$Y_i = \beta X_i + u_i \leq c \qquad \text{excluded,}$$

where $u_i \sim IID\ (0, \sigma^2)$ so that $Y_i \mid X_i \sim IID\ (\beta X_i, \sigma^2)$ and c is any constant. Given X_i in the population, we are therefore interested in the distribution of Y_i given that Y_i is greater than the truncation point c. The mean of this distribution is therefore conditional on the truncation point and will not be equal to the mean of the population distribution. Following from statistical theorems for a truncated normal variable, the probability that Y_i lies above the truncation point c is

$$(3-4) \qquad pr(Y_i > c) = 1 - \Phi[(c - \beta X_i)/\sigma]$$

and the density function, f, of $Y_i > c$, is given by

$$(3-5) \qquad f(Y_i \mid Y_i > c) = \frac{(1/\sigma)\phi[(Y_i - \beta X_i)/\sigma]}{1 - \Phi[(c - \beta X_i)/\sigma]},$$

where $\phi[.]$ is the standard normal probability density function and $\Phi[.]$ is a unit normal cumulative distribution function. It follows that the mean for this distribution is

$$(3-6) \qquad E(Y_i \mid Y_i > c) = \beta X_i + \sigma \frac{\phi[(c-\beta X_i)/\sigma]}{1-\Phi[(c-\beta X_i)/\sigma]}$$

The conditional mean is therefore a nonlinear function of X and β.

Greene shows that the marginal effect in this model for the subpopulation can be expressed as

$$(3-7) \qquad \frac{\partial E(Y_i \mid Y_i > c)}{\partial X_i} = \beta(1-\delta(\alpha_i))$$

where $\delta(\alpha_i) = \lambda(\alpha_i)[\lambda(\alpha_i) - \alpha_i]$,

$\alpha_i = (c - \beta x_i)/\sigma$, and

$\lambda(\alpha_i) = \phi(\alpha_i)/[1-\Phi(\alpha_i)]$.

Greene points out that an important result is that $0 < \delta(\alpha_i) < 1$ for all values of α. This implies that for every element of X_i, the marginal effect is less than the corresponding coefficient. There is a similar attenuation of the variance. In the subpopulation $Y_i > c$, the regression variance is not σ^2, but is

$$(3-8) \qquad Var(Y_i \mid Y_i > c) = \sigma^2(1-\delta(\alpha_i)).$$

Greene also points out that if the inferences to be drawn from the study were to be confined to the subpopulation, the marginal effects derived above would be appropriate for discussion. Conversely, if the analysis is intended to extend to the entire population, it is the coefficient vector β that is of interest.

Estimation begins by firstly expressing the likelihood function, *L*, for a sample of *n* observations. Following from equation (3-5), the likelihood function is the product of these densities;

$$(3-9) \qquad L = \prod_{i=1}^{n} f(Y_i \mid Y_i > c) = \prod_{i=1}^{n} \frac{(1/\sigma)\phi[(Y_i - \beta X_i)/\sigma]}{1-\Phi[(c-\beta X_i)/\sigma]}.$$

The log-likelihood is the sum of the logs of these densities;

$$(3-10) \qquad \mathrm{L} = \ln L = -\frac{n}{2}\ln(\sqrt{2\pi}\sigma) - \frac{1}{2}\sum_{i=1}^{n}[(Y_i - \beta X_i)/\sigma]^2 - \sum_{i=1}^{n}\ln[1-\Phi(\frac{c-\beta X_i}{\sigma})].$$

The likelihood function for this model is globally concave, that is, it has a single maximum; see Olsen (1978) and Amemiya (1973). Greene expresses the first order conditions for a maximum as

$$(3-11) \qquad \frac{\partial \ln L}{\partial \beta} = \sum_{i=1}^{n}[\frac{Y_i - \beta X_i}{\sigma^2} - \frac{\lambda i}{\sigma}]X_i = 0$$

$$(3-12) \qquad \frac{\partial \ln L}{\partial \sigma^2} = \sum_{i=1}^{n}[-\frac{1}{2\sigma^2} + \frac{(Y_i - \beta X_i)^2}{2\sigma^4} - \frac{\alpha_i \lambda_i}{2\sigma^2}] = 0$$

where α_i and λ_i are as defined above.

The extreme non-linearity of equations (3-11) and (3-12) requires the application of iterative numerical methods to obtain the maximum likelihood estimates of β and σ. Three computational algorithms are commonly used: the method of scoring, the Newton-Raphson and an algorithm called the BHHH attributed to Berndt, et al. (1974). To obtain standard errors for the estimates, the Newton-Raphson method uses the inverse of the Hessian matrix, which requires second derivatives of the log-likelihood function, whereas the method of scoring uses the inverse of the expectation of the Hessian, or, in other

words, the negative of the inverse of the information matrix. The BHHH uses the outer product of (3-11) and (3-12) in place of the Hessian. The three algorithms can be expressed generally as

$$(3-13) \qquad \beta_{n+1} = \beta_n - P_n \frac{\partial L}{\partial \beta} |_{\beta_n}$$

where

$$P_n = [\frac{\partial^2 L}{\partial \beta \partial \beta'}]^{-1} |_{\beta_n} \quad \text{for the Newton-Raphson}$$

$$= [E\frac{\partial^2 L}{\partial \beta \partial \beta'}]^{-1} |_{\beta_n} \quad \text{for the method of scoring}$$

$$= -[\Sigma_{i=1}^{n} (\frac{\partial L_i}{\partial \beta})(\frac{\partial L_i}{\partial \beta'})]^{-1} |_{\beta_n} \text{ for the BHHH}$$

Iterations continue until convergence is achieved, that is, β_{n+1} is equal to β_n.

Because of the complicated computations involved in deriving the Hessian for this model, Hausman and Wise (1977) suggested using the BHHH for estimation. The log-likelihood function can, however, be simplified by a re-parameterization. Olsen (1978) suggests letting $\theta = 1/\sigma$ and $\gamma = \theta\beta$, and has shown that in this form the log-likelihood function is easily maximized using Newton's method and the actual Hessian. After estimation of $[\gamma, \theta]$, estimates of $[\beta, \sigma]$ are then recovered from the relationships; $\hat{\beta} = \hat{\gamma}/\hat{\theta}$ and $\hat{\sigma} = 1/\hat{\theta}$. Asymptotic standard errors are recovered in like manner.

A Simultaneous Equation – Truncated Regression Model

The estimation technique applied in this study also takes into account the simultaneous nature of the wage-hour relationship. Considering a wage equation only would obscure the process by which earnings are generated; they result from a choice of hours of work made by the individual, together with the hourly wage that he commands in the market. When investigating the relationship between personal attributes and productivity, we are particularly interested in the wage per unit of time that the individual commands in the market--his marginal product. This relationship would be partly hidden if we look only at his hourly wage. Furthermore, from an econometric standpoint, the variance of the error term in earnings, the product of hours of work and a wage rate, is larger than that of a wage equation. Thus the accuracy with which we can estimate the effect of personal attributes should be greater if we break the relationship into its component parts. For the JSLC surveys, earnings were reported annually, monthly, or weekly, so that if we consider hourly wage, we must also consider hours worked.

Hausman and Wise (1977) presented a simultaneous equations framework that explicitly takes account of both the hourly wage and the hours worked. Their model, outlined below, is used for estimation in this study.

Let Y = earnings, H = hours of work, and W = the hourly wage. Since $Y = H * W$, then

$$\ln Y = \ln H + \ln W . \qquad (3-14)$$

Hausman and Wise assume that in the population ln W and ln H are jointly distributed, and hours worked are a function of the wage rate, among other things. The structural model framework is given as

$$(3-15) \qquad \ln W_i = X_{1i}\delta_1 + \varepsilon_{1i} \quad \text{and}$$

$$(3-16) \qquad \ln H_i = \ln W_i \beta_1 + X_{2i}\delta_2 + \varepsilon_{2i}$$

where ln W_i and ln H_i are endogenous, X_1 and X_2 are vectors of exogenous variables, δ_1 and δ_2 are vectors of parameters, β_1 is a scalar parameter, and ε_1 and ε_2 are jointly normal with expected values zero and covariance matrix given by,

$$(3-17) \qquad \Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{bmatrix}$$

Hausman and Wise further assume only contemporaneous correlation between the disturbance terms. The reduced form of the model then becomes:

$$(3-18) \qquad \ln W_i = X_{1i}\delta_1 + \varepsilon_{1i} \quad \text{and}$$

$$(3-19) \qquad \ln H_i = X_{1i}\delta_1\beta_1 + X_{2i}\delta_2 + \varepsilon_{1i}\beta_1 + \varepsilon_{2i}.$$

The error terms for this reduced form can be rewritten as $V_1 = \varepsilon_1$, and $V_2 = \varepsilon_1 \beta_1 + \varepsilon_2$. The covariance matrix for V_1 and V_2 is given by,

$$(3-20) \qquad \Omega = \begin{bmatrix} \sigma_1^2 & \beta_1\sigma_1^2 + \sigma_{12} \\ \beta_1\sigma_1^2 + \sigma_{12} & \beta_1^2\sigma_1^2 + \sigma_2^2 + 2\beta_1\sigma_{12} \end{bmatrix} = \begin{bmatrix} w_{11} & w_{12} \\ w_{12} & w_{22} \end{bmatrix}.$$

Thus, given X_1 and X_2, ln W and ln H in the population are assumed to have a normal distribution with mean vector $M = (X_{1i}\delta_1, X_{1i}\delta_1\beta_1 + X_{2i}\delta_2)$ and covariance matrix Ω.

Pulling a sub-sample that includes only employed individuals, the selection criterion[5] would be

$$(3-21) \qquad \ln Y_i = \ln H_i + \ln W_i > 0.$$

The joint density function f (.), for observed ln W_i and ln H_i, is then written as

[5] Hausman and Wise (1977) applied the model to a sub-sample of families with earnings at or below one and one-half times the 1967 USA poverty line; hence, the sample selection criterion differs in the present case.

$$(3-22) \qquad f(\ln W_i, \ln H_i) = \begin{cases} 0, & \text{if } \ln H_i + \ln W_i \le 0 \quad \text{and} \\ \dfrac{\phi(\ln W_i, \ln H_i)}{pr(\ln H_i + \ln W_i > 0)}, & \text{if } \ln H_i + \ln W_i > 0 \end{cases}$$

where in this case $\phi(.)$ is a bivariate normal density function with mean vector M and covariance matrix Ω given above.

Recalling that ln W_i + ln H_i is distributed univariate normal with expected value $X_{1i}\,\delta_1 + X_{1i}\,\delta_1\,\beta_1 + X_{2i}\,\delta_2$ and variance $w_{11}+w_{22}+2w_{12}$, the denominator in the expression above is evaluated as

$$(3-23) \qquad pr(\ln H_i + \ln W_i > 0) = \Phi\left[\frac{X_{1i}\,\delta_1 + X_{1i}\,\delta_1\,\beta_1 + X_{2i}\,\delta_2}{\sqrt{w_{11} + w_{22} + 2w_{12}}}\right],$$

where Φ (.) is a unit normal cumulative distribution function. For this case, the likelihood function is given by

$$(3-24) \qquad L = \prod_{i=1}^{n} f(\ln W_i, \ln H_i) = \prod_{i=1}^{n} [\phi(.) / \Phi(.)],$$

and the log-likelihood by

(3-25)

$$L = \ln L = \frac{n}{2}\ln D - \frac{1}{2}\sum_{i=1}^{n}\left[(V_{1i}V_{2i})\,\Omega^{-1}(V_{1i}V_{2i})'\right] - \sum_{i=1}^{n}\ln\Phi\left[\frac{X_{1i}\,\delta_1 + X_{1i}\,\delta_1\,\beta_1 + X_{2i}\,\delta_2}{\sqrt{w_{11} + w_{22} + 2w_{12}}}\right]$$

where D is the determinant of Ω^{-1},

$V_{1i} = ln\ W_i - X_{1i}\,\delta_1$,

$V_{2i} = ln\ H_i - X_{1i}\,\delta_1\,\beta_1 - X_{2i}\,\delta_2$,

$w_{11} = \sigma^2_1$,

$w_{22} = \beta^2_1\,\sigma^2_1 + \sigma^2_2 + 2\,\beta_1\,\sigma_{12}$, and

$w_{12} = \beta_1 \sigma^2_1 + \sigma_{12}$.

This log-likelihood function is maximized to obtain estimates for the structural model parameters β_1, δ_1, δ_2, σ_{11}, σ_{22}, and also σ_{12}, the covariance between ε_1 and ε_2. The function is first maximized with respect to β_1, δ_1, δ_2, w^{11}, w^{22}, and w^{12}, the last three being elements of Ω^{-1}. Estimates of σ_{11}, σ_{22}, and σ_{12} are then solved for from the w^{ij} values and β_1, relying on the invariance theorem. Following this procedure yields consistent, asymptotically unbiased, and efficient parameter estimates that are asymptotically normally distributed (Hausman and Wise (1977), Heckman (1974), Amemiya (1973)).

The usual rules for identification of the parameters also apply to this model. In the present case, identification is assured since the hours-equation would not include the individual's education or work experience. It is assumed that these attributes of individuals, given their wage rate, do not affect their choices between work and leisure. It is, of course, possible that the market not only pays the better-educated and experienced more per unit of time, but also provides them with more possibilities for work. Industry dummies and trade measures are also excluded from the hours-equation. Secondary income, a proxy used for the individual's net assets or wealth, enters the hours-equation but not the wage-equation. Moreover, hours of work are excluded from the wage-equation.

A Model of Labor Supply

Notwithstanding the primary focus of this study, the use of labor force surveys enables more information to be gleaned from the data. Heckman (1974) proposed a model of labor supply that explicitly considers the wage-hour relationship. The model is

applied to derive a common set of parameters which underlie the functions determining the probability that an individual works, his hours of work, his observed wage rate, and his asking wage or shadow price of time. As such, the model relaxes the assumption of no labor-leisure choice made in the H-O type model outlined above. The model relies on two behavioral schedules: the function determining the wage an individual faces in the market--the offered wage, and the function determining the value an individual places on his time--the asking wage. If the individual works, his hours of work adjust to equate these wages if he has freedom to set his working hours. If the individual does not work, no offered wage matches his asking wage. By estimating both wage schedules, the estimated parameters can be used to determine the probability that an individual works, his actual work hours given that he works, the potential market wage rates facing unemployed individuals, and the implicit value of time for unemployed individuals.

In applying the model, Heckman (1974) used a simultaneous-equation extension of the Tobit model since his sample contained observations for both employed and unemployed individuals. He also used a sub-sample of working individuals, but estimated this sample by full information maximum likelihood (FIML), a method that does not take censoring or truncation into account. The model is applied here as a simultaneous equation-truncated regression model, similar to the Hausman and Wise (1977) specification outlined above.

The difference in Heckman's model lies in the theoretical underpinnings of the structural framework. The two wage functions of Heckman's (1974) model are outlined as follows:

$$(3-26) \qquad \ln W_i = X_{1i}\delta_1 + \varepsilon_{1i} \quad \text{and}$$

$$(3-27) \qquad \ln W_i^* = h_i \beta_1 + X_{2i} \delta_2 + \varepsilon_{2i}$$

where in equation (3-27), W^* is the reservation wage of the individual and h is his hours of work, or alternatively, the amount of time the individual does not have available for non-market activities, and X_2 includes variables such as asset income and individual characteristics. Equation (3-26) is the offered wage function, and is as specified in the previous models. The shadow price function expresses the demand for leisure, or, the marginal value of time, and can be seen to be derived in the usual manner as for conventional demand relations for goods, whereby the assumption of utility maximization makes it possible to express the price of a good as a function of the associated quantity, prices of other goods, non-labor income, and other constraints. Economic theory states that if positive quantities of a market good are purchased, a necessary equilibrium condition is that its price equals its marginal value, while if a good is not purchased, its price exceeds its marginal valuation at zero quantities of the good. This condition also applies to the demand for leisure, except that there are two possible corner solutions given a fixed amount of time in the decision period; that is, at zero quantities of leisure, the marginal valuation is less than the market wage, while at the other corner, the marginal valuation at the maximal quantity exceeds the market wage.

If an individual is free to adjust his working hours, an employed individual will have $W = W^*$ as an equilibrium condition. If the individual does not work, (and hours of work cannot be negative), then $W^* \geq W$. Since the offered wage is assumed to be independent of hours worked, and the asking wage is assumed to increase with hours worked, a necessary condition for equilibrium to occur is that at zero hours of work, offered wage exceeds asking wage.

Heckman established that equation (3-27) has a continuous partial derivative with respect to h at $h = 0$, so that, at this point, if $ln(W) > ln(W^*)$, then

$$X_{1i}\delta_i - X_{2i}\delta_2 > \varepsilon_{2i} - \varepsilon_{1i}, \tag{3-28}$$

and hours of work will adjust so that $W = W^*$, the particular adjustment depending in part on the magnitude of the discrepancy ε_2 - ε_1 . Given that condition (3-28) holds for individual i, then the reduced form equations for observed wages and hours become

$$\ln W_i = X_{1i}\delta_1 + \varepsilon_{1i} \tag{3-29}$$

$$h_i = \frac{1}{\beta_1}(X_{1i}\delta_1 - X_{2i}\delta_2) + \frac{\varepsilon_{1i} - \varepsilon_{2i}}{\beta_1}. \tag{3-30}$$

Equations (3-29) and (3-30) are therefore conditional on the inequality (3-28), and since the same variables appear in all three equations, the means and variances of the distributions of (3-29) and (3-30) depend on the values of the exogenous variables for a particular observation. The variance-covariance matrix of the reduced form disturbances in 3-29 and 3-30, Ω, is given as

$$\Omega = \begin{bmatrix} \sigma_1^2 & \dfrac{\sigma_1^2 - \sigma_{12}}{\beta_1} \\ \dfrac{\sigma_1^2 - \sigma_{12}}{\beta_1} & \dfrac{\sigma_1^2 + \sigma_2^2 - 2\sigma_{12}}{\beta_1^2} \end{bmatrix} = \begin{bmatrix} w_{11} & w_{12} \\ w_{12} & w_{22} \end{bmatrix}. \tag{3-31}$$

Heckman points out that it is therefore not possible to obtain unbiased or consistent estimates using OLS since the regressors are correlated with the disturbances and showed that this model could yield asymptotically unbiased, consistent and efficient parameter estimates by applying maximum likelihood techniques. The joint density function, $f[.]$, of observed wages and hours for an individual that works, may be written as

$$(3-32) \qquad f[\ln(W_i), h_i \mid (W_i > W_i^*)_{h=0}] = \frac{\phi[\ln W_i, h_i]}{pr[(W_i > W_i^*)_{h=0}]},$$

where $\phi[.]$ is a bivariate normal density. The denominator, $pr[.]$, is the probability that the individual works, and is equivalent to the condition (3-28) which is distributed as a unit normal cumulative density function with variance equal to $\sigma^2_1+\sigma^2_2-2\sigma_{12}$, where σ^2_1 is the error variance of the offered wage equation (3-26), σ^2_2 is the error variance of the shadow wage equation (3-27), and σ_{12} is the covariance between the two; see Heckman p.692 for derivation. The probability that the individual works may then be written as

$$(3-33) \qquad pr[(W_i > W_i^*)_{h=0}] = \Phi\left[\frac{X_{1i}\,\delta_1 - X_{2i}\,\delta_2}{\sqrt{\sigma_1^2+\sigma_2^2-2\sigma_{12}}}\right].$$

For a sub-sample truncated for individuals with positive earnings, the log-likelihood function for n observations for the Heckman model can be written as

$$(3-34) \qquad L = \ln L = \frac{n}{2}\ln D - \frac{1}{2}\sum_{i=1}^{n}\left[(V_{1i}V_{2i})\,\Omega^{-1}(V_{1i}V_{2i})'\right] - \sum_{i=1}^{n}\ln\Phi\left[\frac{X_{1i}\,\delta_1 - X_{2i}\,\delta_2}{\sqrt{\sigma_1^2+\sigma_2^2-2\sigma_{12}}}\right]$$

where D is the determinant of Ω^1. For this log-likelihood function, the errors are now defined as

$V_{1i} = ln\ W_i - X_{1i}\,\delta_1$, and

$V_{2i} = h_i - (X_{1i}\,\delta_1 - X_{2i}\,\delta_2)\,/\,\beta_1$.

As for the Hausman and Wise model, estimation involves maximizing the log-likelihood function with respect to the structural form parameters and the elements of the inverse of the covariance matrix for the reduced form equations, and consequently, solving for the variances of the structural model. The main difference between the models then, is that in the Heckman model the scale factor of the joint distribution of wages and

hours of work for employed individuals is based on the theoretical assumption that the individual will choose to work if the offered wage exceeds his asking wage at zero hours of work, and will then choose his supply of work hours so that he is in equilibrium. In the Hausman and Wise model, the scale factor is based on the econometric assumption of the simultaneity of wages and hours of work. Another difference is that the scalar parameter β_1 appears only in the $\phi[.]$ for the Heckman model, but appears in both the $\phi[.]$ and the $\Phi[.]$ for the Hausman and Wise model. A further difference is that, in the Heckman model hours are estimated normally distributed (although it is implicit that $ln(W^*) \sim NIID$) while it is the logarithm of hours that is the dependent variable in the Hausman and Wise construct.

Data and Descriptive Statistics

The sample is restricted to individuals between 14 and 65 years old who are not retired or permanently disabled, and includes workers from all industries, including those employed outside the traded goods sector. Using the Jamaica Industrial Classification (JIC) four-digit code, workers were grouped to correspond to eight single-digit sections of the Standard International Trade Classification (SITC)--see Appendix 1. The goods group SITC4--animal and vegetable oils and fats--was excluded because of too few observations. Moreover, trade figures for this section are negligible--see Appendix 2.

Starting with 17,137 observations pooled over the nine-year period 1990-1998, and after deleting for implausible observations and those with no earnings or missing information for individual controls, the sample is left with 15,003 observations.[6] The

[6] The 1992 dataset (and consequently the 1991 trade measures) was not included in the study sample because of a missing control variable.

dependent variable for the wage-equation is the natural log of average hourly earnings, defined as total earned income divided by total hours worked for the reported period, deflated by the average annual Jamaica Consumer Price Index (CPI). Definitions of the control variables, together with some summary statistics are listed in Table 3-1. The mean age in the sample is 36.5 years. Fifty-three percent are between ages 14 and 35, 23% are in the age group 36-45, and the remaining 24% are 45 to 65 years old. Figure 3-1 shows the mean wage, skill and hours of work for these age groups. The data sample shows that on average, Jamaican employees below age 36 have higher education levels but have a lower wage level than their older counterparts.

The mean years of formal education are 8.6 for the sample. Forty-eight percent are educated up to the primary school level (up to 7 years schooling), another 49% are educated up to the secondary level (up to 13 years schooling), and the remaining 3 % have some tertiary education. Figure 3-2 shows the mean years of schooling, wage, and hours of work for these education level categories. There it is shown that wages rise with years of formal education for the sample. Figure 3-3 shows a comparison of the mean wages and skill for individuals employed in the different SITC industries. Five industries pay wages above the sample average, the other three paying at or below the average. The figures also show that seven of the eight SITC industries employ individuals with skill levels at or above the sample average.

Figures 3-4 through 3-11 show imports and exports, as compared to their 1989 levels, for selected years for the eight SITC industries. The figures show that, in general, the growth in imports has significantly exceeded that of exports over the period 1989-1997.

Table 3-1: Definitions of Control Variables and Summary Statistics

VARIABLE	DEFINITION	MEAN[a]	STD. DEV.
Ln(wage)	Natural log of real wage per hour	1.59	1.79
Ln(hours)	Natural log of hours worked weekly	3.73	2.02
Annual Hours	Hours worked weekly*52	2159.14	390.70
SITC0-Food	= 1 if employed in S.I.T.C 0; = 0 otherwise	26.8	44.3
SITC1-Bev&Tobacco	= 1 if employed in S.I.T.C 1; = 0 otherwise	0.4	6.0
SITC2-Crude Materials	= 1 if employed in S.I.T.C 2; = 0 otherwise	0.7	8.5
SITC3-Mineral Fuels	= 1 if employed in S.I.T.C 3; = 0 otherwise	0.8	8.9
SITC5-Chemicals	= 1 if employed in S.I.T.C 5; = 0 otherwise	0.3	5.3
SITC6-Manuf. Goods	= 1 if employed in S.I.T.C 6; = 0 otherwise	1.9	13.6
SITC7-Mach&Transp	= 1 if employed in S.I.T.C 7; = 0 otherwise	0.4	0.066
SITC8-Other Manuf.	= 1 if employed in S.I.T.C 8; = 0 otherwise	4.4	20.6
Age	Worker's Age	36.48	12.43
Skill	Number of years of Formal Education	8.60	2.61
Potex	Potential Experience is age-(skill+6)	21.88	13.72
Potex-squared	Potex*Potex		
Male	= 1 if worker is male; = 0 otherwise	56.0	49.0
Married	= 1 if worker is married	41.0	49.0
HHH	=1 if worker is head of the household; = 0 otherwise	49.0	50.0
LUR	Local (Parish) Unemployment Rate	16.02	4.69
Income2	Secondary Income – Weekly (J$ deflated)	108.25	166.29
Exports	Value of exports (US$'000), by industry, by year	216534	96466
Imports	Value of imports (US$'000), by industry, by year	305731	103243
Trend	Time trend = 1 to 9 for 1990 to 1998	6.1	2.74

[a] The means for all dummy variables are the percentages of the sample for which the variable equals one. The means for Income2 and the trade variables are computed from the proportions of the sample for which these variables are positive – 7.66% and 42.84%, respectively.

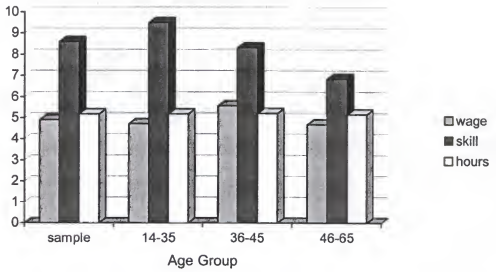

Figure 3-1: Wage, Skill, and Hours Worked by Age Group

Note: wage is measured in J$/hour(C.P.I. deflated), skill in years of formal education, hours in number of eight-hour work days.

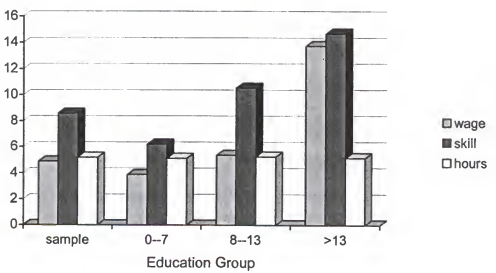

Figure 3-2: Wage, Skill, and Hours Worked by Education Group

Note: wage is measured in J$/hour(C.P.I. deflated), skill in years of formal education, hours in number of eight-hour work days.

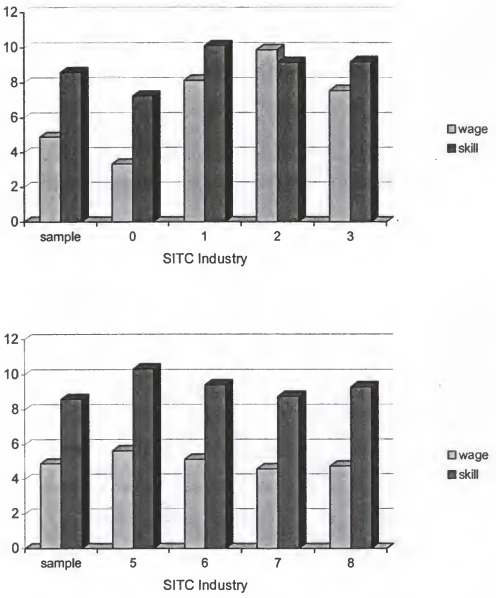

Figure 3-3: Wage and Skill by 1-digit SITC Section

Note: wage is measured in J$/hour(C.P.I. deflated), skill in years of formal education.

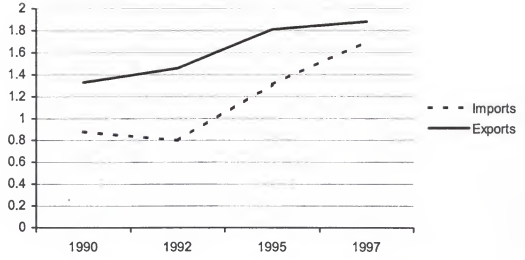

Figure 3-4: Trade Growth for SITC0-Food: 1990-1997 (1989=1)

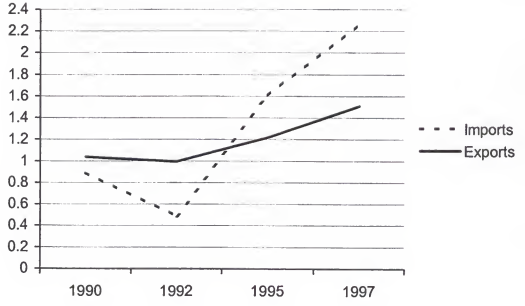

Figure 3-5: Trade Growth for SITC1-Beverages and Tobacco: 1990-1997 (1989=1)

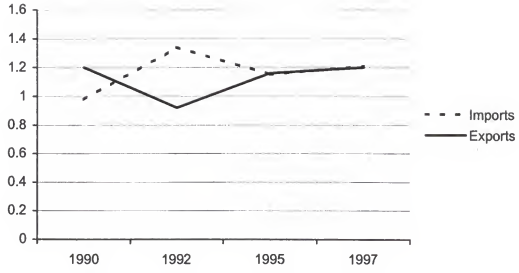

Figure 3-6: Trade Growth for SITC2-Crude Materials: 1990-1997 (1989=1)

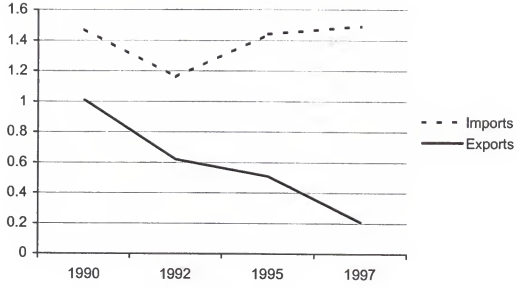

Figure 3-7: Trade Growth for SITC3-Mineral Fuels: 1990-1997 (1989=1)

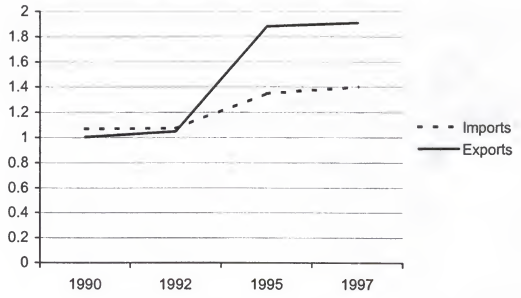

Figure 3-8: Trade Growth for SITC5-Chemicals: 1990-1997 (1989=1)

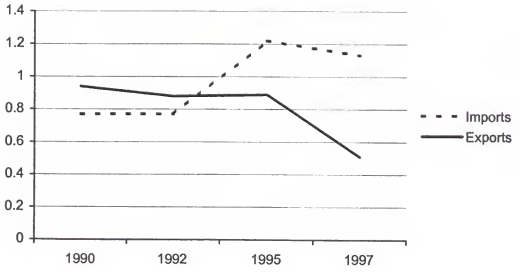

Figure 3-9: Trade Growth for SITC6-Manufactured Goods: 1990-1997 (1989=1)

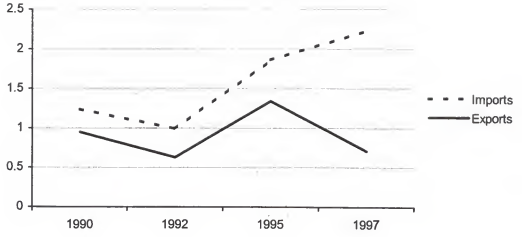

Figure 3-10: Trade Growth for SITC7-Machinery and Transport Equipment: 1990-1997 (1989=1)

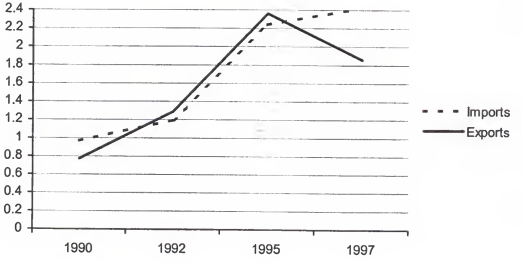

Figure 3-11: Trade Growth for SITC8-Miscellaneous Manufactures: 1990-1997 (1989=1)

CHAPTER 4
ANALYSIS OF EMPIRICAL RESULTS

Parameter Estimates and Model Selection

Parameter estimates were obtained using the TSP computer software package (Hall, Schnake, and Cummins, (1987)). The log likelihood functions were numerically maximized using the BHHH algorithm as implemented in the package. Estimates and their standard errors for the wage equation (3-1) obtained by OLS and single-equation maximum likelihood are presented in Table 4-1. Many of the maximum likelihood estimates are larger than the corresponding OLS estimates, giving an indication of the bias of the least squares estimates. In particular, the maximum likelihood estimate of the coefficient on education is approximately 50% larger than the corresponding least squares estimate, a finding similar to that by obtained other researchers (see, for e.g., Hausman and Wise (1977)). This implies, as was argued in the previous section, that taking explicit account of the truncation leads to parameter estimates that are larger than the biased least squares estimates.

The estimated parameters and their asymptotic standard errors for the simultaneous wage and hours equations as proposed by Hausman and Wise are given in Table 4-2. Table 4-3 gives the structural parameter estimates and standard errors for the Heckman labor supply model. Further estimates for the labor supply model using data for

trade with the USA and Trinidad and Tobago are presented in Tables 4-4 and 4-5, respectively.[7]

For the simultaneous equations models, although the wage equation (3-1) is nested in both the Hausman and Wise and the Heckman models, the two are not directly related because the hours-equation of the Hausman and Wise model is structurally different from the shadow wage equation of the Heckman model (differences were highlighted in the previous section).[8] One approach that may be used to compare the models is a comparison of the covariances. For both models, the disturbances capture such omitted variables as ability, quality of schooling, and taste factors. Working on the assumption that such factors will have a positive effect on the wage rate as well as the number of hours worked and/or a shadow wage, it is expected that the covariance between the structural equations of both models should be positive. The estimated variances and covariances and their asymptotic standard errors are given in Table 4-6. For the Hausman and Wise model, the estimated covariance between the structural equations is -.024. The negative sign obtained for this estimate suggests that the data do not support the structure of the Hausman and Wise model as specified in equations (3-15) through (3-20); in opposition, the sign of the estimated covariance between the offered wage and the shadow wage in the Heckman model is positive, and thus theoretically consistent, based on the assumptions made. The ratio of this estimate to its standard error is 8.58 and is therefore significantly different from zero at better than the one percent level. This provides strong evidence that the model is indeed simultaneous.

[7] Estimated asymptotic standard errors using White's (1982) method are presented in the appendix.
[8] It should be noted that the nomenclature adopted is for differentiating between the estimated models, and it is the wage equation as proposed by Lovely and Richardson that is of main interest.

Table 4-1: Wage Equation Parameter Estimates from OLS and Truncated Regression: Maximum Likelihood (ML)

VARIABLE	OLS Wage Equation Estimates (Standard Errors)	Truncated Regression: ML Wage Equation Estimates (Standard Errors)
Age ≤ 35	-.032	-.037
	(.022)	(.031)
Age ≥ 45	.016	.019
	(.026)	(.037)
Experience	.023	.032
	(.002)**	(.003)**
Experience-squared.	$-.337\times10^{-3}$	$-.463\times10^{-3}$
	$(.358\times10^{-4})$**	$(.542\times10^{-4})$**
Skill	.097	.149
	(.007)**	(.010)**
Male	.253	.353
	(.012)**	(.018)**
Married	.116	.164
	(.012)**	(.018)**
Head of Household	.056	.081
	(.013)**	(.018)**
Local Unemployment Rate	-.010	-.014
	(.001)**	(.002)**
SITC0	-.771	-2.711
	(.222)**	(.379)**
SITC1	-.844	-2.083
	(.459)*	(.656)**
SITC2	.721	-.026
	(.274)**	(.377)
SITC3	.011	-.544
	(.273)	(.384)
SITC5	-.456	-1.537
	(.479)	(.698)**
SITC6	-.186	-.903
	(.206)	(.305)**
SITC7	-.243	-1.017
	(.367)	(.550)*
SITC8	-.142	-1.734
	(.267)	(.443)**
SITC0*Skill	.016	.163
	(.026)	(.042)**
SITC1*Skill	.092	.196
	(.046)**	(.066)**

Table 4-1--continued

VARIABLE	OLS Wage Equation Estimates (Standard Errors)	Truncated Regression: ML Wage Equation Estimates (Standard Errors)
SITC2*Skill	-.028	.035
	(.029)	(.040)
SITC3*Skill	.028	.076
	(.029)	(.041)*
SITC5*Skill	.040	.128
	(.047)	(.067)**
SITC6*Skill	.015	.073
	(.022)	(.032)**
SITC7*Skill	.026	.091
	(.041)	(.059)
SITC8*Skill	-.013	.113
	(.030)	(.048)**
Exports	.015	.539
	(.181)	(.296)*
Exports*Skill	.003	-.037
	(.021)	(.032)
Imports	.291	.650
	(.150)**	(.239)**
Imports*Skill	-.025	-.057
	(.017)	(.026)**
Trend	.040	.086
	(.009)**	(.013)**
Trend*Skill	$.557\times10^{-3}$	-.003
	$(.953\times10^{-3})$	(.001)**
Constant	-.071	-.905
	(.081)	(.122)**
	$\sigma = .691$	$\sigma = .832$

* Statistically significant at the .10 level
** Statistically significant at the .05 level

Table 4-2: Parameter Estimates for the (Hausman and Wise) Simultaneous-Equation Maximum Likelihood

VARIABLE	Wage Equation Estimates (Standard Errors)	Hours Equation Estimates (Standard Errors)
Age ≤ 35	-.025	.008
	(.011)**	(.002)**
Age ≥ 45	.025	-.005
	(.012)**	(.003)*
Experience	.025	
	(.001)**	
Experience-squared.	$-.377\times10^{-3}$	
	$(.166\times10^{-4})$**	
Skill	.100	
	(.003)**	
Male	.256	.069
	(.006)**	(.002)**
Married	.114	.008
	(.006)**	(.002)**
Head of Household	.054	.011
	(.006)**	(.002)**
Local Unemployment Rate	-.010	$.454\times10^{-3}$
	$(.612\times10^{-3})$**	$(.202\times10^{-3})$**
SITC0	-.693	
	(.104)**	
SITC1	-.716	
	(.230)**	
SITC2	.724	
	(.146)**	
SITC3	.046	
	(.136)	
SITC5	-.381	
	(.194)**	
SITC6	-.167	
	(.111)	
SITC7	-.145	
	(.168)	
SITC8	-.070	
	(.125)	
SITC0*Skill	.007	
	(.012)	
SITC1*Skill	.076	
	(.023)**	

Table 4-2--continued

VARIABLE	Wage Equation Estimates (Standard Errors)	Hours Equation Estimates (Standard Errors)
SITC2*Skill	-.037	
	(.016)**	
SITC3*Skill	.019	
	(.014)	
SITC5*Skill	.030	
	(.022)	
SITC6*Skill	.013	
	(.012)	
SITC7*Skill	.018	
	(.021)	
SITC8*Skill	-.018	
	(.014)	
Exports	-.024	
	(.085)	
Exports*Skill	.006	
	(.010)	
Imports	.298	
	(.067)**	
Imports*Skill	-.024	
	(.008)**	
Trend	.043	.009
	(.004)**	$(.362\times10^{-3})$**
Trend*Skill	$.231\times10^{-3}$	
	$(.448\times10^{-3})$	
Second Income		$.996\times10^{-4}$
		$(.159\times10^{-4})$**
Log Wage/hr		.061
		(.003)**
Constant	-.123	3.518
	(.039)**	(.005)**
	$\sigma_{11} = .488$	$\sigma_{12} = -.024$ $\sigma_{22} = .152$

* Statistically significant at the .10 level

** Statistically significant at the .05 level

Table 4-3: Parameter Estimates for the (Heckman Labor Supply Model) Simultaneous-Equation Maximum Likelihood

VARIABLE	Offered-Wage Equation Estimates (Standard Errors)	Asking-Wage Equation Estimates (Standard Errors)
Age ≤ 35	-.025	-.145
	(.011)**	(.034)**
Age ≥ 45	.028	.096
	(.012)**	(.037)**
Experience	.025	
	(.001)**	
Experience-squared.	$-.381\times10^{-3}$	
	$(.165\times10^{-4})$**	
Skill	.101	.037
	(.003)**	(.007)**
Male	.258	-.942
	(.006)**	(.067)**
Married	.114	-.130
	(.006)**	(.030)**
Head of Household	.054	-.214
	(.006)**	(.032)**
Local Unemployment Rate	-.009	
	$(.575\times10^{-3})$**	
SITC0	-.687	
	(.104)**	
SITC1	-.716	
	(.228)**	
SITC2	.686	
	(.143)**	
SITC3	.061	
	(.134)	
SITC5	-.388	
	(.192)**	
SITC6	-.181	
	(.110)*	
SITC7	-.140	
	(.163)	
SITC8	-.083	
	(.124)	
SITC0*Skill	.006	
	(.012)	
SITC1*Skill	.073	
	(.023)**	

Table 4-3--continued

VARIABLE	Offered-Wage Equation Estimates (Standard Errors)	Asking-Wage Equation Estimates (Standard Errors)
SITC2*Skill	-.037	
	(.015)**	
SITC3*Skill	.015	
	(.014)	
SITC5*Skill	.028	
	(.022)	
SITC6*Skill	.014	
	(.012)	
SITC7*Skill	.016	
	(.020)	
SITC8*Skill	-.018	
	(.014)	
Exports	-.042	
	(.085)	
Exports*Skill	.008	
	(.010)	
Imports	.301	
	(.066)**	
Imports*Skill	-.024	
	(.008)**	
Trend	.044	-.147
	(.004)**	(.012)**
Trend*Skill	$.117\times10^{-3}$	
	$(.443\times10^{-3})$	
Second Income		-.002
		$(.236\times10^{-3})$**
Annual Hours		.0075
		$(.430\times10^{-3})$**
Constant	-.147	-13.686
	(.038)**	(.783)**
	$\sigma_{11} = .488$	$\sigma_{12} = .102$ $\sigma_{22} = 1.985$

* Statistically significant at the .10 level

** Statistically significant at the .05 level

Table 4-4: Parameter Estimates for the Heckman Labor Supply Model: Simultaneous-Equation Maximum Likelihood (USA-Jamaica Trade)

VARIABLE	Offered-Wage Equation Estimates (Standard Errors)	Asking-Wage Equation Estimates (Standard Errors)
Age ≤ 35	-.025	-.144
	(.011)**	(.035)**
Age ≥ 45	.029	.102
	(.012)**	(.039)**
Experience	.025	
	(.001)**	
Experience-squared.	$-.380\times10^{-3}$	
	$(.165\times10^{-4})$**	
Skill	.103	.034
	(.003)**	(.007)**
Male	.258	-.993
	(.006)**	(.072)**
Married	.113	-.144
	(.006)**	(.032)**
Head of Household	.054	-.228
	(.006)**	(.033)**
Local Unemployment Rate	-.009	
	$(.574\times10^{-3})$**	
SITC0	-.640	
	(.076)**	
SITC1	-.263	
	(.245)	
SITC2	1.080	
	(.141)**	
SITC3	.382	
	(.138)**	
SITC5	-.848	
	(.194)**	
SITC6	-.038	
	(.106)	
SITC7	.071	
	(.158)	
SITC8	.392	
	(.121)**	
SITC0*Skill	.003	
	(.009)	
SITC1*Skill	.035	
	(.025)	

Table 4-4--continued

VARIABLE	Offered-Wage Equation Estimates (Standard Errors)	Asking-Wage Equation Estimates (Standard Errors)
SITC2*Skill	-.067	
	(.015)**	
SITC3*Skill	-.012	
	(.014)	
SITC5*Skill	.063	
	(.023)**	
SITC6*Skill	.003	
	(.011)	
SITC7*Skill	$.506\times10^{-3}$	
	(.020)	
SITC8*Skill	-.057	
	(.013)**	
Exports	.323	
	(.050)**	
Exports*Skill	-.025	
	(.005)**	
Imports	-.246	
	(.066)**	
Imports*Skill	.022	
	(.007)**	
Trend	.047	-.156
	(.004)**	(.013)**
Trend*Skill	$-.195\times10^{-3}$	
	$(.438\times10^{-3})$	
Second Income		-.002
		$(.248\times10^{-3})$**
Annual Hours		.008
		$(.466\times10^{-3})$**
Constant	-.167	-14.321
	(.038)**	(.848)**
	$\sigma_{11} = .488$	$\sigma_{12} = .096$ $\sigma_{22} = 2.076$

* Statistically significant at the .10 level

** Statistically significant at the .05 level

Table 4-5: Parameter Estimates for the Heckman Labor Supply Model: Simultaneous-Equation Maximum Likelihood (Trinidad-Jamaica Trade)

VARIABLE	Offered-Wage Equation Estimates (Standard Errors)	Asking-Wage Equation Estimates (Standard Errors)
Age ≤ 35	-.026	-.145
	(.011)**	(.034)**
Age ≥ 45	.027	.096
	(.012)**	(.037)**
Experience	.025	
	(.001)**	
Experience-squared.	$-.380\times10^{-3}$	
	$(.165\times10^{-4})$**	
Skill	.110	.037
	(.003)**	(.007)**
Male	.257	-.946
	(.006)**	(.066)**
Married	.113	-.132
	(.006)**	(.030)**
Head of Household	.055	-.215
	(.006)**	(.032)**
Local Unemployment Rate	-.009	
	$(.574\times10^{-3})$**	
SITC0	-.293	
	(.086)**	
SITC1	-.273	
	(.225)	
SITC2	1.210	
	(.173)**	
SITC3	.701	
	(.189)**	
SITC5	-.014	
	(.187)	
SITC6	.162	
	(.106)	
SITC7	.293	
	(.164)*	
SITC8	.528	
	(.077)**	
SITC0*Skill	-.016	
	(.008)**	
SITC1*Skill	.045	
	(.022)**	

Table 4-5--continued

VARIABLE	Offered-Wage Equation Estimates (Standard Errors)	Asking-Wage Equation Estimates (Standard Errors)
SITC2*Skill	-.070	
	(.018)**	
SITC3*Skill	-.038	
	(.021)*	
SITC5*Skill	.006	
	(.021)	
SITC6*Skill	-.008	
	(.011)	
SITC7*Skill	-.011	
	(.020)	
SITC8*Skill	-.059	
	(.008)**	
Exports	-.044	
	(.072)	
Exports*Skill	$.167\times10^{-3}$	
	(.007)	
Imports	-.028	
	(.011)**	
Imports*Skill	.003	
	(.001)**	
Trend	.061	-.148
	(.004)**	(.012)**
Trend*Skill	-.001	
	$(.396\times10^{-3})$**	
Second Income		-.002
		$(.235\times10^{-3})$**
Annual Hours		.0075
		$(.430\times10^{-3})$**
Constant	-.253	-13.735
	(.036)**	(.782)**
	$\sigma_{11} = .488$	$\sigma_{12} = .102$ $\sigma_{22} = 1.992$

* Statistically significant at the .10 level

** Statistically significant at the .05 level

Table 4-6: Estimated Variances and Covariance: Simultaneous Equations Models

Parameter	Estimate	Asymptotic Standard Error
Hausman and Wise		
σ_{11}	.488	.044**
σ_{12}	-.024	.001**
σ_{22}	.152	.016**
Heckman		
σ_{11}	.488	.044**
σ_{12}	.102	.012**
σ_{22}	1.985	.770**

Note: Estimates for Hausman and Wise and Heckman taken from Tables 4-2 and 4-3 respectively.
** Statistically significant at the .05 level

Moreover, a Wald test strongly rejects the hypothesis that the parameter estimates of the shadow wage equation are jointly zero; the calculated statistic is 920.2 as compared to the tabled value for the $\chi^2(9)$ at the .005 level of 23.6. The following discussion is therefore based on estimates obtained from the Heckman labor supply model.

Results and Discussion

Control Variables

The control variables along with a year trend were used to estimate a base version of the labor supply model that omits the trade variables. Table 4-7 shows the coefficients and standard errors for the individual control variables. The coefficient estimates on the experience variable and its square are strongly significant, and the negative sign obtained on the square of experience reflects that the data are consistent with the normally assumed inverted "U" experience-earnings profile. Evaluated at the mean years of experience, together the estimates suggest a 1.7% increase in wages for each year of additional experience in the labor market. The estimated coefficients on skill and its

interaction with the time trend are .108 and -.001, respectively, and both these estimates are also strongly significant. Together they suggest that for the period 1990-1998 in Jamaica, the average rate of return on an additional year of investment in formal education, measured in hourly wages, was approximately 10%, but during the same period, this rate declined by about one tenth of 1% per year, implying that the demand for skilled labor in the economy has trended downward, albeit rather slightly.

Age was entered in three groups to avoid singularity of the data for estimating the wage-equation.[9] The coefficients obtained indicate that, ceteris paribus, younger Jamaican workers earn wages that are 2.5% below the average wage of their middle-aged counterparts, while workers above 44 years of age earn wages 2.8% above that average. All the other coefficients in the offered-wage equation are of the expected sign, and are of reasonable magnitudes, not dissimilar from findings of other studies done for Jamaica--see for e.g., Scott (1992). The results suggest that Jamaican men earn over 25% more than Jamaican women, married persons earn 11% more than unmarried persons, and an individual who is the head of the household is offered 5.5% more in wages than an individual who is not. A unit increase in the unemployment rate in Jamaica is estimated to decrease the wage offered in the labor market by almost one percent. The results also suggest that real wages in Jamaica have trended upward between 1990 and 1998 by about 6% per year.

The effects of age on the asking wage show that younger individuals have a lower reservation wage, and suggest that the asking wage increases with age. The results also

[9] If the age variable is used, singularity would arise because of the way the experience variable is defined – see Table 4-1. Dummy variables as defined below were used instead to represent three age-groups, and coefficient estimates were obtained for the first and last:

$$AGE_1 = \begin{cases} 1, & if \quad age \le 35; \\ 0, & otherwise. \end{cases} \quad AGE_2 = \begin{cases} 1, & if \quad 35 < age < 45 \\ 0, & otherwise. \end{cases} \quad AGE_3 = \begin{cases} 1, & if \quad age \ge 45 \\ 0, & otherwise. \end{cases}$$

show that the demographics, being male, married, and the head of the household, all serve to reduce an individual's asking wage while placing a positive marginal value on each year of his/her investment in formal education. The skill coefficient in the asking wage is, however, much smaller than in the offered wage, and the difference is significant.[10] This implies that ceteris paribus more educated Jamaicans work more frequently, and work longer hours than less educated persons. A one dollar increase in non-wage assets, measured here as weekly secondary income, is estimated to lower an individual's reservation wage by a small but statistically significant amount. As expected, increases in hours worked are associated with increases in the marginal value of remaining units of time used for leisure. The estimated coefficients may be used to generate other interesting results such as labor supply response to an increase in wages. An exogenous increase in the wage rate is equivalent to a shift in the intercept of the offered wage equation. From the reduced form equation (3-30),

$$\frac{\partial h_i}{\partial \delta_0} = \frac{1}{\beta_1},$$

where δ_0 is the intercept of the wage equation, measured in units of natural logarithms of real hourly wages. The estimate of β_1 is .0075, thus this partial is estimated at 133. This implies that a unit increase in the natural logarithm of the wage rate will result in an individual supplying 133 additional hours of work per year. It should be noted though that a unit increase in the log of the wage rate represents an almost threefold increase in the real wage rate.

[10] The difference in coefficients is .071 and the estimated asymptotic standard error is .007.

Table 4-7: Base Regression Results for Control Variables: Labor Supply Model.

VARIABLE	Offered-Wage Equation Estimates (Standard Errors)	Asking-Wage Equation Estimates (Standard Errors)
Age ≤ 35	-.025	-.145
	(.011)**	(.034)**
Age ≥ 45	.028	.096
	(.012)**	(.037)**
Experience	.026	
	(.001)**	
Experience-squared.	$-.382\times10^{-3}$	
	$(.165\times10^{-4})$**	
Skill	.108	.037
	(.003)**	(.007)**
Male	.257	-.945
	(.006)**	(.067)**
Married	.113	-.131
	(.006)**	(.030)**
Head of Household	.055	-.215
	(.006)**	(.032)**
Local Unemployment Rate	-.009	
	$(.574\times10^{-3})$**	
SITC0	-.379	
	(.021)**	
SITC1	-.328	
	(.215)	
SITC2	1.006	
	(.126)**	
SITC3	.434	
	(.115)**	
SITC5	-.096	
	(.177)	
SITC6	.104	
	(.095)	
SITC7	.205	
	(.146)	
SITC8	.449	
	(.058)**	
SITC0*Skill	-.012	
	(.002)**	
SITC1*Skill	.047	
	(.021)**	

Table 4-7--continued

SITC2*Skill	-.057	
	(.013)**	
SITC3*Skill	-.012	
	(.011)	
SITC5*Skill	.011	
	(.020)	
SITC6*Skill	-.005	
	(.009)	
SITC7*Skill	-.007	
	(.020)	
SITC8*Skill	-.054	
	(.006)**	
Second Income		-.002
		$(.235\times10^{-3})$**
Annual Hours		.0075
		$(.430\times10^{-3})$**
Trend	.059	-.148
	(.003)**	(.012)**
Trend*Skill	-.001	
	$(.378\times10^{-3})$**	
Constant	-.240	-13.725
	(.035)**	(.782)**
$\sigma_1 = .488$	$\sigma_{12} = .102$	$\sigma_2 = 1.990$

* Statistically significant at the .10 level
** Statistically significant at the .05 level

For a 10% increase in the average real wage per hour, additional supply of labor for the year would be 7.9 hours or approximately one day's work. The corresponding elasticity is .037, evaluated at the mean hours of annual labor supply. This arguably small response could reflect, in part, the constraints of institutional arrangements and work norms whereby the number of hours an individual can choose to work may be restricted.

Industry-Specific Wage Premiums

Table 4-7 also displays the fixed-effect estimates of the industry-specific labor and skill premiums obtained from the base regression. A joint test that this set of

parameters is equal to zero, against the alternative that they are nonzero, is considered using a Wald test. The test statistic has a value of 5479.4, while the tabled value for the $\chi^2(16)$ at the .005 level is 34.3. The null is therefore strongly rejected, providing evidence that wage differences in Jamaica can be explained by inter-industry labor and skill premiums.

Three industries, food (SITC0), beverages and tobacco (SITC1), and chemicals (SITC5), have labor premiums below the average wage. Of the three, however, only the food group is statistically significant at the 5% level. This is consistent with the widely held view that agriculture and related industries are low-wage sectors. The category crude materials (SITC2) has the highest labor premium above the average, a statistically significant result that is also consistent with the Jamaican situation where the bauxite industry pays premiums considered by some to be the best in the country. Two industries, mineral fuel, lubricants and related products (SITC3), and miscellaneous manufactured articles (SITC8), which include the furniture and garment sub-sectors, also pay labor premiums in excess of 40% above the average wage.

Figure 4-1 depicts the fixed-effect estimates of the industry-specific premiums attached to different amounts of education. Only two industries have rising skill premiums–beverages and tobacco and chemicals–while one industry–machinery and transport equipment–has a profile that is essentially flat. Most of the SITC groups show premiums that decline as the years of formal education of the employee increase.

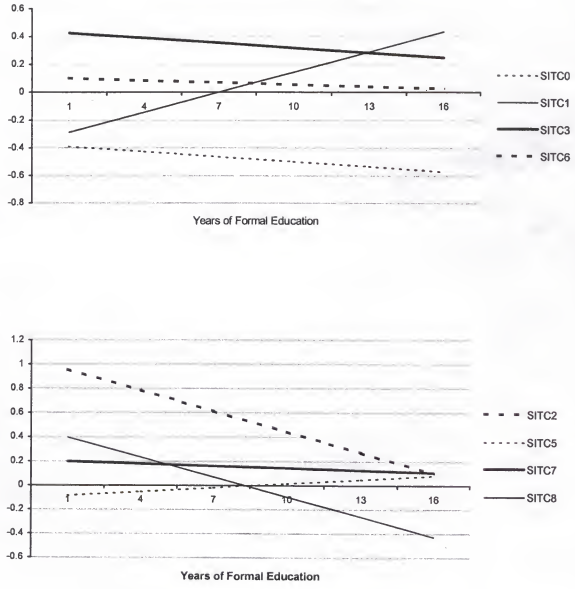

Figure 4-1: Industry-Specific Wage Premiums by Education Level (Deviation from Employment-Weighted Average Log Real Wage)

This declining premium could reflect a variety of factors, including lower industry-specific (dis)utility experienced by more highly skilled workers, greater locational mobility of more highly educated workers, or greater intersectoral mobility of educated workers. Together, these results for labor and skill premiums suggest that

different labor market conditions for skilled and unskilled workers, are an important part of the explanation of industry wage premiums in Jamaica. The existence of industry wage premiums, therefore, may be less a phenomenon of particular industry structure and more a reflection of the local, industry-specific nature of the labor market facing the less skilled.

Wage Trade Correlations

The main interest is how these wage and skill premiums correlate with measures of trade for Jamaica, both as an aggregate, and disaggregated by different trading partners, represented here by the USA as a developed country (vertical) trading partner, and Trinidad and Tobago as a developing country (horizontal) partner. Table 4-8 records the estimates and standard errors of the coefficients on the trade variables in the wage equations. The entries under "Total Trade," "USA Trade" and "Trinidad Trade" are taken from Tables 4-3, 4-4, and 4-5, respectively. The sign of the coefficient on a trade measure is interpreted as the sign of the correlation between that trade flow and the return to pure labor (given by the industry-specific intercepts). Similarly, the sign of the coefficient on the interaction between education and a trade measure is interpreted as the sign of the correlation between that trade flow and the return to each year of education for a worker in a specific industry.

Much of the recent literature asserts that skilled and unskilled workers in an industry experience the same industry wage premiums. For comparison purposes, the correlation between such standard premiums (that is, excluding the industry-education interactions) and the measures of trade were also estimated.[11] The results appearing in the

[11] The regression results for this estimation are presented in the appendix.

first column of Table 4-8 show that increased imports have a strong positive correlation with Jamaican wage premiums while exports show no significant relationship.

Table 4-8: Selected Coefficients (Standard Errors) of Real Log Wage on Trade Measures from Simultaneous Equations Model

	Std. Premium (Standard Errors)	Total Trade		USA Trade		Trinidad Trade	
		Labor Premium (Standard Errors)	Skill Premium (Standard Errors)	Labor Premium (Standard Errors)	Skill Premium (Standard Errors)	Labor Premium (Standard Errors)	Skill Premium (Standard Errors)
Industry Imports	.084 (.030)**	.300 (.066)**	-.024 (.008)**	-.245 (.066)**	.022 (.007)**	-.028 (.011)**	.003 (.001)**
Industry Exports	-.030 (.037)	-.041 (.085)	.008 (.010)	.323 (.050)**	-.025 (.005)**	-.044 (.072)	$.19\times10^{-3}$ (.007)

* Statistically significant at the .10 level
** Statistically significant at the .05 level

Distinguishing skilled workers from those less skilled provides some insight into these results. The second column in Table 4-8, under the heading "Total Trade", suggests that increased trade, and the direction of trade, have opposing effects on the return to pure labor and the return to skill. It can be seen that the positive effect of increasing imports on the standard premiums is strongly driven by higher premiums for pure labor, while skilled workers experience a lower return--a 10% increase in aggregate imports is estimated to shift industry-specific labor premiums upward by 3% of the average wage, while decreasing the industry-specific rate of return on education by .24%. The opposite effect is suggested for increased export trade--increased exports lead to lower premiums for less skilled workers, and higher premiums for workers with more skill--but these export coefficients are not statistically significant.

Further insight is provided when trade is disaggregated into type of trading partner. For trade with the USA, the distributional pattern is reversed compared to that for

aggregate trade. Increased export trade with the USA is associated with higher industry premiums for less skilled workers in the traded goods sectors in Jamaica, and lower premiums for skilled workers. Conversely, higher import penetration from USA goods is associated with lower premiums for the less skilled, but is positively related to wage premiums for skilled workers.

Trade with less developed countries, as represented by trade with Trinidad, shows a different distributional pattern from that of trade with the USA. As with the USA, increased import penetration from Trinidadian goods into Jamaica is associated with lower wage premiums for the less skilled and higher premiums for skilled workers in Jamaica. The magnitudes are however much smaller–for any of the eight industries, a 10% increase in imports from the USA will lead to a downward shift in the wage premium paid by that industry by approximately 2.5% of the average wage, and an increase in that industry's specific rate of return on education by about .22%, while a similar increase in imports from Trinidad will shift the industry's wage premium schedule downward by only .3%, and increase the industry-specific rate of return on education by .03%. Increased export intensity to Trinidad shows no statistically significant impact on wages, but the signs obtained on the estimates suggests lower premiums for the less skilled and higher premiums for the more skilled--which is the reverse effect for exports to the USA.

A direct estimate of the effect of a trade flow in industry j on the wage of individual i in that industry is obtained from wage equation (3-1) as

$$\frac{\partial \ln(w_{ij})}{\partial T_j} = \dot{w_{Lj}} + S_{ij}\dot{w_{Sj}} + \dot{\beta_{Lj}} + S_{ij}\dot{\beta_{Sj}}$$

$$= (w_{Li}^{*} + \beta_{Li}^{*}) + S_{ij}(w_{Sj}^{*} + \beta_{Sj}^{*}),$$

and therefore depends on the educational level of the employee. Using the estimates of w_L^{*}, w_S^{*}, β_L^{*} and β_S^{*} from Table 4-4, i.e., the estimates for Jamaican trade with the USA, real hourly wages earned by two different employees in each of the eight industries, under different trade scenarios, are presented in Table 4-9. The two employees are representative of the typical individual in the sample but differ by two standard deviations around the mean years of formal education for the sample, i.e., one is assumed to have 6 years of formal education, the other, 11.2 years. The table shows that over the period 1989-1997, increased imports lowered the real wages earned by both skilled and unskilled employees in the traded goods sectors in Jamaica, with unskilled workers losing more, thus increasing the wage gap between the skilled and the unskilled. The analysis also shows that increased exports had the desirable effects of increasing real wages for both the skilled and the unskilled and at the same time reducing the wage gap. The wage changes are also greater in absolute value for the analyzed change in exports than for the same percentage change in imports. Noting that import levels for most of the eight industries were higher than export levels in 1989, the analysis suggests exports affect wages positively and by a larger margin than the negative change that would be brought about by imports of a similar dollar value.

The Agricultural Wage

The wage premiums paid in the food sector (SITC0) are of particular interest. As depicted in Figure 4-1 above, the results suggest that employees in agricultural industries face wages that are less than two-thirds of the average wage across the economy, and that premiums decline with their educational level.

Table 4-9: Analysis of the Effects of Trade Changes on the Wages of the Typical Unskilled and Skilled Employee

	1989 Trade Level			50% Increase in Imports			50% Increase in Exports		
	UW[a]	SW	WG	UW	SW	WG	UW	SW	WG
Average Wage[b]	3.56	5.82	1.63						
SITC Sections									
0. Food	2.03	3.33	1.64	1.92	3.33	1.73	2.22	3.40	1.53
1. Beverages & Tobacco	3.58	6.91	1.93	3.39	6.91	2.04	3.91	7.06	1.81
2. Crude Materials excluding Fuel	7.44	8.45	1.13	7.03	8.45	1.20	8.12	8.63	1.06
3. Mineral Fuels, Lubricants, etc.	5.15	7.78	1.51	4.87	7.78	1.60	5.62	7.95	1.42
5. Chemicals	2.36	5.27	2.23	2.23	5.27	2.36	2.58	5.38	2.09
6. Manufactured Goods classed by Materials	3.70	6.02	1.63	3.49	6.02	1.73	4.03	6.15	1.53
7. Machinery and Transport Equipment	4.07	6.56	1.61	3.84	6.56	1.71	4.44	6.70	1.51
8. Misc. Manufactured Articles	3.97	4.75	1.20	3.75	4.75	1.27	4.33	4.85	1.12

a: UW = unskilled wage; J$/hour(C.P.I. deflated) earned by the typical worker with 6 years of formal education
SW = skilled wage; J$/hour (C.P.I. deflated) earned by the typical worker with 11.2 years of formal education
WG = wage gap; SW÷UW

b: The average wage in the non-traded goods and services sectors.

The implication, as brought out in Table 4-9, is that more-educated workers in the food sector earn less than less-educated workers in the other traded-goods sectors. Table 4-9 also suggests that trade in general has minimal effect on the wages earned in this sector; an employee with high school education earning $3.33 per hour will see his wage unchanged if agricultural imports were to increase by 50%, and would see only a seven cent per hour pay increase if agricultural exports were to increase by 50%.

These results are consistent with the standard problem in agriculture vis-à-vis economic development, i.e., the low wages are indicative of the excess supply of labor in the agricultural sector that needs to be shifted out to the non-farm sectors. The results also point to the low productivity in the agricultural sector, and with the end of preferential marketing for the two main agricultural exports--sugar and bananas--will come even more depressed wages and greater unemployment in the sector. To the extent that a country's standard of living depends on the income of the people, together with the fact that over one quarter of the Jamaican workforce is employed in agriculture, the importance of the sector cannot be overstated. It is apparent then, that increases in agricultural productivity are necessary if workers employed in the sector are to make a meaningful living from their employment. Such increases in productivity can come through enhanced public investment in human capital in the sector. Langham and Davis (1998) point out that this investment is best translated into general and continuing education of farm decision makers, support of agricultural research activities in the retention of good scientists and adaptation of new cost-efficient technologies, and in the collection and dissemination of information needed by both agricultural producers and policy makers.

Efficient use of resources and increases in productivity are necessary to be competitive in the global economy, and if the sector is export-driven, productivity gains in export industries will spin-off to non-exporting industries (Feder (1983)). Opportunities exist for Jamaican agricultural exports. Non-traditional crops and value-added products have potential for targeting niche markets in developed country trading partners, especially in the USA where consumers are becoming more discriminating in their food-purchasing behavior and are increasingly segmented into subgroups based on lifestyles, location, and other demographics (Taylor, et al. (1997)). Witter (1997) shows that non-traditional agricultural exports have done well relative to traditional exports since 1989, but points out that this is explained in part by their low starting base. More can be done. Taylor, et al. indicate that with few commercial plantings of non-traditional crops in the Caribbean, the shear size of the USA market and the demand for consistent supplies of high quality products place Caribbean producers of non-traditional products at a disadvantage. Transforming agricultural enterprises to more commercially based activities deserves more attention in this regard. Jamaica's exotic-tropical image also needs to be further exploited in the marketing of non-traditional agricultural products that may not be competitive on the basis of price.

Issues of food security also come to the fore. The risk of losing access to adequate food for all Jamaicans is apparent with an ever-increasing food import bill, the resultant displacement of some agricultural activities by imports, high national debt servicing, and stagnant or negative economic growth. Thomas and Davis (2000) provide a thorough evaluation of the issues surrounding food security from the perspective of developing countries in the context of liberalization and globalization. In extending

recommendations, Thomas and Davis highlight that while the access to adequate food supplies of satisfactory nutritional levels is primarily determined by production and income, a complex array of cultural, social, behavioral health and environmental factors also have to be taken into account, including extension of the knowledge of these factors to households.

CHAPTER 5
SUMMARY, POLICY RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Summary and Conclusions

The main purpose of this dissertation has been to empirically determine the impact that liberalization of trade has had on the wages of skilled and unskilled workers in Jamaica, and to test these results against the hypotheses of the formal trade models. Elaboration of the problem to be addressed and the specific objectives were given in Chapter 1. There it was noted that the importance of the study is linked to the growing debate on issues surrounding globalization and income distribution. Advocates for freer trade have long argued that increasing global engagement has positive overall effects on the incomes and growth of the countries involved. Recently, however, voices have emerged that argue that the benefits of globalization are not evenly distributed, and that there are even groups that lose in the process.

From the perspective of a small developing country, trade models have posited that such a country will have a comparative advantage if they export the good that uses the abundant factor of production intensively, and consequently, the returns to this factor will increase more relative to that for the scarce factor. In Chapter 2 the theoretical framework and analytical model for the study were outlined in more detail. The usual assumption under such models is that small developing countries have an abundance of

unskilled labor relative to skilled labor, and this assumption was incorporated into the present study. The analytical model also extends the framework to distinguish between Jamaican trade with developed country partners--vertical trade--and trade with other developing countries--horizontal trade.

Annual household surveys for the period 1990-1998, along with annual import and export data disaggregated into single-digit SITC sectors, were utilized. The annual surveys are characterized as repeated cross-sections (R.C.S.)--distinguishable from panel data--since the respondents were changed, and more than once, over the period under consideration. This feature of the data does not disallow pooling of the annual samples, and for the purposes of this study pooling has no adverse effect on the reliability of the results. Since the labor data set includes the industry where the individual was employed, the labor data were combined with the trade data to isolate the effects of changes in trade by industrial sector on the components of pure labor and skill.

This model of industry-specific wage premiums was estimated by different methods including single-equation and simultaneous-equations truncated regression. The econometric methods employed and related considerations were discussed in Chapter 3. A labor demand-and-supply model that specifies a shadow wage for the individual performed best with the data, and its utility provided additional information of interest. To take account of a special feature of the data sample--only observations on employed individuals were drawn from the survey data and used for the analysis--a truncated regression was applied to the simultaneous demand and supply equations, with the truncation factor modeled as the individual's decision to work. The model was estimated in turn for aggregate Jamaican trade with the rest of the world (ROW), Jamaican trade

with developed country partners as represented by trade with the USA, and Jamaican trade with other developing countries as represented by trade with Trinidad and Tobago.

In Chapter 4 the empirical results were presented and discussed. One of the main findings suggested by the results is that the direction of Jamaican trade, and with whom Jamaica trades, seems to matter for Jamaican wage inequality. The results for trade with the ROW suggest that exports in aggregate have no discernible impact on the wages earned by individuals employed in the traded goods sectors. Aggregate imports on the other hand, were found to shift industry-specific wage schedules upward while reducing the returns paid to skill in the traded goods industries. A reverse effect was found, however, for imports from the USA--a downward shift in industry-specific wage schedules and increased returns to years of investment in formal education. The opposing effect was found for exports to the USA. The results suggest that increased exports to developed country partners, as represented by trade with the USA, are associated with an upward shift in industry-specific wage schedules and a lower premium paid to the skill component in each industry in the traded goods sector. Another important finding is that industry-specific wage premiums are more responsive to increases in exports than for a similar percentage increase in imports. Together these results for trade with the USA indicate that for two workers in an industry who differ only in years of formal education, increased imports will increase the wage inequality between them, with a larger portion of the resultant inequality being borne by the loss in wages for the less skilled worker. Conversely, the indication is that increased exports to developed countries will narrow the inequality of earned income between the two workers, with the magnitudes of the effects resulting in increased wages for both workers as the upward shift in the industry-

specific wage schedule more than offsets the resultant lower premium paid to the skill component. The results for Jamaican trade with Trinidad and Tobago, representative of trade with other developing countries, suggests that increased imports from Trinidad results in a similar effect as for imports from the USA, but the magnitude is considerably smaller, and minimal. No discernible effect on wages was detected for increased exports to Trinidad and Tobago.

These results are interpreted in accordance with the analytical models that assume differences in the types of trade that Jamaica conducts with developed- and developing-country trading partners and differences in the types of labor markets faced by less-skilled and more-skilled workers. With some exceptions, the empirical results are largely consistent with the conceptual pattern of the directional effects of trade shocks on wage premiums. Exceptions include the indiscernible effects of exports in aggregate, and exports to developing-country partners. Two conclusions may be drawn from this result. One is that, over the period considered, even with much liberalization of trade policies, and while exports to the USA show some impact, Jamaican exports have not grown in sufficient quantities, in total, to significantly impact the wages of workers. The second is that, Jamaican horizontal exports--exports to developing-country partners--have grown less than vertical exports, thus dampening the impact for exports in total. The other departure from the expected results is the relationship between wage premiums and imports from developed-country partners. The reverse effect reflected by the results may be attributed to the composition of imports from the USA--a large part of Jamaica's import bill from the USA is for food, fuel, and miscellaneous manufactured articles. These are, arguably, not skill-intensive products, counter to the assumption given for

Jamaican vertical imports, hence the departure of signs of the estimated effects from those of the conceptual directional effects.

The results also support a view of labor markets in Jamaica that is to some extent industry-specific, generating different industry-specific components to wages and returns to education. The results show pronounced differences in the size of these industry wage premiums across industries and between workers, and thus, pronounced differences in the way trade affects them. In particular, it was found that industry wage premiums for less educated workers are much larger than for more educated workers.

Secondary results pertaining to the Jamaican labor market were also obtained from the estimated model. Among these is the labor supply response to an exogenous change in the wage rate, which was found to be relatively small. It was also found that real wages have trended upward over the period under review, and that there was a reduction in the demand for skilled labor in the economy over the same period. This latter finding is consistent with that of previous studies; see for e.g., Anderson and Witter (1994), Alleyne (2000).

The results, in sum, suggest that for a developing country such as Jamaica, both what is traded, and with whom, impacts on Jamaican wage inequality. The relationships, however, are complex, and this study provides only a basic interpretation of these matters, but more importantly, extends a framework from which further investigation into these issues may be pursued.

Policy Implications and Recommendations

The extent to which trade has been the cause of the increasing skill differentials in the global economy has occupied economists increasingly over the last ten years. Among the alternatives to trade as the cause for these changes in labor markets, the most prominent is technology; that is, technological progress has been biased in favor of skilled labor, either within industries or across industries. While it has become clear that both trade and technology affect wage inequality, the debate continues over the complexity of the issues and the appropriate methodologies for drawing these conclusions (see e.g., Deardorff (2000), Krugman (2000), Leamer (2000)). If, however, the response to the problem is to determine the appropriate policies to redistribute income more equitably, then, as argued by Deardorff (1999), it matters not if trade or technology caused the increased income inequality. More important is that trade-distorting policies are only second best to this end. Deardorff (1999) shows that, of the available policies for redistribution, the preferred policy will be a tax-subsidy focused more directly on the factors employed, that is, skilled-unskilled labor, and that this preference will hold regardless of the relative contributions of trade or technology to the problem of income inequality.

Some economists have pointed out that wage inequality is not all bad; Welch (1999) calls it an economic "good" stating that wages play many roles in the economy, not least of which is the signaling of relative scarcity and abundance, and with adaptable skills, wages provide incentives to render the services that are most highly valued. Welch points to the increased levels of school-completion rates following periods of increasing education wage premiums in the USA as the positive side of wage inequality. The issue

then becomes one of providing access to education that provides the skills that are required by the changing structure of the economy.

The findings of this investigation are in support of long-standing recommendations by other researchers (see for e.g., Witter (1997), Shirley (1997)), and those brought out above, and in the section on the agricultural wage, underscore the importance of education in the wage-trade paradigm. If Jamaica were committed to facilitating profitable trade-related investments, a key ingredient would be a commitment to pertinent education and a critical assessment of industries and activities that hold the potential for the highest benefits and returns to education. As new economic arrangements emerge from the growing, and seemingly irreversible, processes of trade liberalization and globalization, Jamaica needs to take action in implementing workable policies that will ensure that she is not left behind in the new global economy. It is hoped that this investigation has provided some information in this regard.

Limitations of the Study and Suggestions for Further Research

This research has focused on the issue of globalization vis-à-vis wage inequality and an investigation of the Jamaican case. Some limitations were encountered in carrying out the investigation, and are grounds for further research. One limitation was access to pertinent data. Movements in average tariff rates across industries for the period under review would have provided a more direct, and hence preferable, measure of the extent of the liberalization of trade in Jamaica. While trade flows can reflect trade policy changes, additional factors help to determine the volume of trade and thus may not be innocuous in its use. Tariff rates were not obtainable, either from the finance ministry or the statistical

agencies. Results from use of tariff rates could be tested against the results obtained in this study.

In interpreting the results, an extrapolation was made from the representative country to the type of trading partner. This assumption could be questioned; a complete disaggregation of Jamaican imports and exports into the two categories, trade with developed-country partners and trade with developing-country partners, might provide more representative estimates in this regard. This is another area in which the model applied in this study could be improved upon.

The labor force survey data also have shortcomings that were pertinent to the study. No information was collected on the union membership of the respondents, and this is an important explanatory variable in wage determination studies. It should also be noted that because they are household surveys, in any given household there may be more than one respondent, and the way in which the data were collected makes it impossible to determine the allocation of children among the respondents from a household. This other important control variable--the number of children each respondent has--had to be omitted from the analysis.

It was pointed out that because of the way the data were sampled for this study, a truncated regression was necessary. However, the estimated model is better suited for a tobit analysis that would include data on the unemployed. By applying the tobit model, more information could be gleaned from the data, such as the predicted probabilities of being in the employed work force for different segments of the population. It would also be interesting to compare the tobit estimates with those obtained here.

The use of repeated cross-section (R.C.S.) data is another source of limitation to the extent that the analysis could be done. The absence of the panel nature of the data meant that individuals could not be tracked over time, and as Ashenfelter, et al. (1986, p.15) point out "The question of 'who benefits from development' requires some sort of repeated observations (at least on groups) for an adequate answer." To this end, Deaton (1985) suggests using the R.C.S. surveys to form a pseudo-panel of cohorts that could be tracked over time. Economic relationships are then estimated based on cohort means rather than individual observations. Cohorts could be based on any characteristic that defines a segment of the population such as age or educational level.[12] For an investigation into the effects of trade on wage inequality, educational levels within industries could define cohorts, and this would be a next logical step for empirical analysis.

[12] Baltalgi (1995) gives an overview on the formation of pseudo-panels and the special issues involved; Verbeek (1992) and Verbeek and Nijman (1993) provide more details on estimation with pseudo-panels: Moffitt (1993) extends the discussion to estimation of dynamic models with pseudo-panels.

APPENDIX 1
ALLOCATION OF JAMAICA INDUSTRIAL CLASSIFICATION (JIC) CATEGORIES TO THE STANDARD INTERNATIONAL TRADE CLASSIFICATION (SITC) SECTORS

SITC 1-digit Sector to which allocated	JIC Categories
0 – Food	0xxx+2111+2112+2113+212x+213x+214x
1 – Beverages and Tobacco	215x+216x
2 – Crude Materials	1xxx
3 – Mineral Fuels, Lubricants etc.	26xx
5 – Chemicals	25xx+272x
6 – Manufactured Goods	221x+222x+224x+231x+241x+242x+271x +28xx+30xx+31xx+32xx
7 – Machinery & Transport Equip	331x+332x+334x+335x+336x+3370+3371+3372 +34xx+35xx+36xx+37xx+38xx+39xx
8 – Miscellaneous Manufactures	223x+225x+232x+233x+290x+3373+3381+3382 +3383+3384+3385+3386

APPENDIX 2
VALUE OF JAMAICAN IMPORTS AND EXPORTS BY SITC SECTORS
(1989-1997)

Appendix 2-1: Value of Total Jamaican Exports, 1989-97, by SITC Sectors - US$'000

SITC Sections	1989	1990	1991	1992	1993	1994	1995	1996	1997
0. Food	144550	192792	204527	210263	226811	212068	262199	277989	271751
1. Beverages & Tobacco	35510	36917	32347	35323	40645	40460	43233	47523	53434
2. Crude Materials excluding Fuel	613997	736512	662023	566744	531991	619543	711707	692600	738916
3. Mineral Fuels, Lubricants, etc.	16307	16534	11600	10108	6559	6024	8388	5975	3460
4. Animal & Vegetable Oils & Fats	25	31	258	39	1482	1543	883	26	23
5. Chemicals	24479	24575	22466	25792	25441	25233	45934	46693	46793
6. Manufactured Goods classed by Materials	21821	20451	18747	19196	16064	21440	19354	19415	11173
7. Machinery and Transport Equipment	32076	30361	90944	20269	14308	28435	42938	31590	22868
8. Misc. Manufactured Articles	128220	99347	102257	165850	211924	264873	302116	265066	238905

Source: Statistical Institute of Jamaica (STATIN), Various Publications.

Appendix 2-2: Value of Total Jamaican Imports, 1989-97, by SITC Sectors - US$'000

SITC Sections	1989	1990	1991	1992	1993	1994	1995	1996	1997
0. Food	262118	231568	216743	208449	259719	251102	343559	365570	445089
1. Beverages & Tobacco	22861	20354	14982	11133	16714	26657	36797	35803	51905
2. Crude Materials excluding Fuel	47099	45901	52836	63125	63215	64820	54000	51305	57118
3. Mineral Fuels, Lubricants, etc.	274262	403746	327174	316922	343869	329114	394639	444255	408554
4. Animal & Vegetable Oils & Fats	15217	17854	13831	11339	11575	18204	20079	23378	23653
5. Chemicals	211453	225774	223733	226798	205067	221347	284743	294355	296148
6. Manufactured Goods classed by Materials	382935	295603	288296	296288	358238	354719	468670	407702	434029
7. Machinery and Transport Equipment	396033	488949	460529	391811	564441	554630	735836	778628	884442
8. Misc. Manufactured Articles	183857	178639	181581	219827	313030	365376	412474	435648	447399

Source: Statistical Institute of Jamaica (STATIN), Various Publications.

Appendix 2-3: Value of Jamaican Exports to USA, 1989-97, by SITC Sectors - US$'000

SITC Sections	1989	1990	1992	1993	1994	1995	1996	1997
0. Food	22430	30327	31610	40665	35625	42645	51419	51621
1. Beverages & Tobacco	15698	16753	13127	14709	16216	18720	19663	24791
2. Crude Materials excluding Fuel	195408	189740	168413	150811	113956	121007	137514	114810
3. Mineral Fuels, Lubricants, etc.	2487	3333	1503	330	1236	330	2136	542
4. Animal & Vegetable Oils & Fats	-	-	-	-	-	-	-	-
5. Chemicals	3560	20073	6312	6032	8566	28152	27038	25311
6. Manufactured Goods classed by Materials	3518	4143	5567	2903	4185	4270	6720	3263
7. Machinery and Transport Equipment	10429	8455	7104	4816	10602	15309	12518	12338
8. Misc. Manufactured Articles	113903	84278	152622	197619	250606	290375	253911	230226

Source: Statistical Institute of Jamaica (STATIN), Various Publications.

Appendix 2-4: Value of Jamaican Imports from USA, 1989-97, by SITC Sectors - US$'000

SITC Sections	1989	1990	1992	1993	1994	1995	1996	1997
0. Food	110091	112528	105857	128035	130686	178372	203648	177228
1. Beverages & Tobacco	4092	4018	3290	3248	3747	5261	6730	11318
2. Crude Materials excluding Fuel	36720	38440	56893	53992	54815	44803	39431	42440
3. Mineral Fuels, Lubricants, etc.	86083	184945	106448	118843	123088	136038	141530	139745
4. Animal & Vegetable Oils & Fats	-	-	-	-	-	-	-	-
5. Chemicals	123585	139189	138237	116667	127133	160048	177569	121389
6. Manufactured Goods classed by Materials	182267	139366	155796	164285	166047	206429	206401	135866
7. Machinery and Transport Equipment	187609	183536	195462	247226	273123	345830	372804	282136
8. Misc. Manufactured Articles	139817	136321	173783	253315	307244	336154	347865	414721

Source: Statistical Institute of Jamaica (STATIN), Various Publications.

Appendix 2-5: Value of Jamaican Exports to Trinidad & Tobago, 1989-97, by SITC Sectors - US$'000

SITC Sections	1989	1990	1992	1993	1994	1995	1996	1997
0. Food	4012	4500	5370	4056	4180	4526	3693	3937
1. Beverages & Tobacco	480	630	258	281	179	198	201	466
2. Crude Materials excluding Fuel	370	1625	452	2666	250	239	25	231
3. Mineral Fuels, Lubricants, etc.	1483	920	1501	737	391	1459	324	57
4. Animal & Vegetable Oils & Fats	-	-	-	-	-	-	-	-
5. Chemicals	9116	9867	8053	6745	5994	5417	5380	4236
6. Manufactured Goods classed by Materials	9283	7499	5397	4228	6553	5639	3404	1834
7. Machinery and Transport Equipment	2277	2337	2076	1126	1062	1921	1620	1943
8. Misc. Manufactured Articles	4304	4574	3228	2019	1967	1778	2385	1869

Source: Statistical Institute of Jamaica (STATIN), Various Publications.

Appendix 2-6: Value of Jamaican Imports from Trinidad & Tobago, 1989-97, by SITC Sectors - US$'000

SITC Sections	1989	1990	1992	1993	1994	1995	1996	1997
0. Food	11997	12091	3184	7737	13780	18225	20662	24711
1. Beverages & Tobacco	11018	8144	1866	5352	13769	21877	16099	17894
2. Crude Materials excluding Fuel	27	19	62	33	53	207	184	229
3. Mineral Fuels, Lubricants, etc.	5966	3941	757	33873	57022	135443	169678	156399
4. Animal & Vegetable Oils & Fats	-	-	-	-	-	-	-	-
5. Chemicals	5671	6946	5653	7478	8946	12916	11387	11950
6. Manufactured Goods classed by Materials	18667	15340	14918	18156	17824	16453	13323	20193
7. Machinery and Transport Equipment	4651	3646	3534	3772	3997	4414	2920	3234
8. Misc. Manufactured Articles	1993	2248	2147	2490	2978	4505	4568	5872

Source: Statistical Institute of Jamaica (STATIN), Various Publications.

APPENDIX 3
PARAMETER ESTIMATES OF THE SIMULTANEOUS EQUATIONS MODELS WITH STANDARD ERRORS CORRECTED FOR MISSPECIFICATION

Appendix 3-1: Parameter Estimates for the (Hausman and Wise) Simultaneous-Equation Maximum Likelihood: Standard Errors Corrected for Misspecification.

VARIABLE	Wage Equation Estimates (Standard Errors)	Hours Equation Estimates (Standard Errors)
Age < 35	-.025	.008
	(.021)	(.005)*
Age > 45	.025	-.005
	(.026)	(.009)
Experience	.025	
	(.002)**	
Experience-squared.	$-.377\times10^{-3}$	
	$(.349\times10^{-4})$**	
Skill	.100	
	(.007)**	
Male	.256	.069
	(.012)**	(.004)**
Married	.114	.008
	(.012)**	(.004)**
Head of Household	.054	.011
	(.012)**	(.004)**
Local Unemployment Rate	-.010	$.454\times10^{-3}$
	(.001)**	$(.379\times10^{-3})$
SITC0	-.693	
	(.217)**	
SITC1	-.716	
	(.410)*	
SITC2	.724	
	(.233)**	
SITC3	.046	
	(.254)	
SITC5	-.381	
	(.591)	
SITC6	-.167	
	(.175)	

Appendix 3-1--continued

VARIABLE	Wage Equation Estimates (Standard Errors)	Hours Equation Estimates (Standard Errors)
SITC7	-.145	
	(.385)	
SITC8	-.070	
	(.258)	
SITC0*Skill	.007	
	(.025)	
SITC1*Skill	.076	
	(.042)*	
SITC2*Skill	-.037	
	(.025)	
SITC3*Skill	.019	
	(.028)	
SITC5*Skill	.030	
	(.052)	
SITC6*Skill	.013	
	(.019)	
SITC7*Skill	.018	
	(.039)	
SITC8*Skill	-.018	
	(.029)	
Exports	-.024	
	(.178)	
Exports*Skill	.006	
	(.020)	
Imports	.298	
	(.154)*	
Imports*Skill	-.024	
	(.018)	
Trend	.043	.009
	(.008)**	$(.709\times10^{-3})$**
Trend*Skill	$.231\times10^{-3}$	
	$(.914\times10^{-3})$	
Second Income		$.996\times10^{-4}$
		$(.316\times10^{-4})$**
Log Wage/hr		.061
		(.005)**
Constant	-.123	3.518
	(.077)	(.010)**
	$\sigma_{11} = .488$	$\sigma_{12} = -.024$ $\sigma_{22} = .152$

* Statistically significant at the .10 level

** Statistically significant at the .05 level

Appendix 3-2: Parameter Estimates for the (Heckman) Simultaneous-Equation Maximum Likelihood: Standard Errors Corrected for Misspecification.

VARIABLE	Offered-Wage Equation Estimates (Standard Errors)	Asking-Wage Equation Estimates (Standard Errors)
Age < 35	-.025	-.145
	(.021)	(.068)**
Age > 45	.028	.096
	(.025)	(.078)
Experience	.025	
	(.002)**	
Experience-squared.	$-.381\times10^{-3}$	
	$(.343\times10^{-4})$**	
Skill	.101	.037
	(.007)**	(.013)**
Male	.258	-.942
	(.012)**	(.130)**
Married	.114	-.130
	(.012)**	(.061)**
Head of Household	.054	-.214
	(.012)**	(.063)**
Local Unemployment Rate	-.009	
	(.001)**	
SITC0	-.687	
	(.213)**	
SITC1	-.716	
	(.404)*	
SITC2	.686	
	(.232)**	
SITC3	.061	
	(.250)	
SITC5	-.388	
	(.587)	
SITC6	-.181	
	(.172)	
SITC7	-.140	
	(.385)	
SITC8	-.083	
	(.253)	
SITC0*Skill	.006	
	(.024)	
SITC1*Skill	.073	
	(.041)*	

Appendix 3-2--continued

VARIABLE	Offered-Wage Equation Estimates (Standard Errors)	Asking-Wage Equation Estimates (Standard Errors)
SITC2*Skill	-.037	
	(.025)	
SITC3*Skill	.015	
	(.028)	
SITC5*Skill	.028	
	(.052)	
SITC6*Skill	.014	
	(.019)	
SITC7*Skill	.016	
	(.039)	
SITC8*Skill	-.018	
	(.028)	
Exports	-.042	
	(.175)	
Exports*Skill	.008	
	(.020)	
Imports	.301	
	(.152)**	
Imports*Skill	-.024	
	(.018)	
Trend	.044	-.147
	(.008)**	(.023)**
Trend*Skill	$.117\times10^{-3}$	
	$(.902\times10^{-3})$	
Second Income		-.002
		$(.470\times10^{-3})$**
Annual Hours		.0075
		$(.828\times10^{-3})$**
Constant	-.147	-13.686
	(.077)*	(1.499)**
	$\sigma_{11} = .488$	$\sigma_{12} = .102$ $\sigma_{22} = 1.985$

* Statistically significant at the .10 level

** Statistically significant at the .05 level

APPENDIX 4
PARAMETER ESTIMATES OF THE LABOR SUPPLY MODEL: REGRESSION WITH STANDARD INDUSTRY WAGE-TRADE PREMIUMS

VARIABLE	Offered-Wage Equation Estimates (Standard Errors)	Asking-Wage Equation Estimates (Standard Errors)
Age ≤ 35	-.053	-.262
	(.012)**	(.045)**
Age ≥ 45	.091	.219
	(.015)**	(.055)**
Experience	.028	
	(.001)**	
Experience-squared.	$-.433\times10^{-3}$	
	$(.212\times10^{-4})$**	
Skill	.117	.052
	(.003)**	(.009)**
Male	.291	-.870
	(.007)**	(.152)**
Married	.093	-.112
	(.007)**	(.048)**
Head of Household	.071	.002
	(.007)**	(.039)
Local Unemployment Rate	-.011	
	$(.691\times10^{-3})$**	
SITC0	-.125	
	(.056)**	
SITC1	-.295	
	(.186)	
SITC2	1.036	
	(.109)**	
SITC3	.435	
	(.106)	
SITC5	-.294	
	(.153)**	
SITC6	.349	
	(.112)**	
SITC7	.777	
	(.261)**	

Appendix 4--continued

VARIABLE	Offered-Wage Equation Estimates (Standard Errors)	Asking-Wage Equation Estimates (Standard Errors)
SITC8	.444	
	(.089)**	
SITC0*Skill	-.013	
	(.004)**	
SITC1*Skill	.036	
	(.018)**	
SITC2*Skill	-.068	
	(.011)**	
SITC3*Skill	-.021	
	(.010)**	
SITC5*Skill	.021	
	(.017)	
SITC6*Skill	-.031	
	(.010)**	
SITC7*Skill	-.075	
	(.029)**	
SITC8*Skill	-.067	
	(.007)**	
Exports	-.030	
	(.037)	
Imports	.084	
	(.030)**	
Trend	.043	-.178
	(.004)**	(.029)**
Trend*Skill	$-.224\times10^{-3}$	
	$(.444\times10^{-3})$	
Second Income		-.005
		$(.833\times10^{-3})$**
Annual Hours		.0085
		(.001)**
Constant	-.271	-15.859
	(.042)**	(2.067)**
	$\sigma_{11} = .443$	$\sigma_{12} = .072$ $\sigma_{22} = 2.108$

* Statistically significant at the .10 level

** Statistically significant at the .05 level

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BIOGRAPHICAL SKETCH

Ewan B. Scott was born on his father's birthday January 5, 1964 in Ocho Rios, Jamaica. He grew up in the coastal town St. Ann's Bay, and at age 16, after finishing high school, he moved to the hilly rural interior where he had his first exposure to, and gained first hand experience in, the realities of small farming in Jamaica. At age 19--in 1983--after finishing a 2-year spell as the youngest firefighter in Jamaica, Ewan's love for agriculture took him to the College of Agriculture, Passley Gardens, Jamaica, where he graduated as an Associate of Science in general agriculture. Ewan then rejoined the labor market for five years-shared between agricultural credit banking with a government agency and farm management on sugar cane plantations--before continuing his education in agriculture at the University of the West Indies, St. Augustine campus, Trinidad. There, between 1991 and 1995, Ewan achieved a Bachelor of Science in agriculture and a Master of Science in agricultural economics, with specialization in agribusiness management and marketing. In fall 1995, he started his doctoral program in the Food and Resource Economics Department at the University of Florida.

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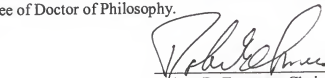

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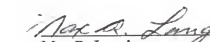

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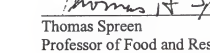

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This dissertation was submitted to the Graduate Faculty of the College of Agriculture and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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